## ELECTRICITY APPLIED TO EXPLOSIVE PURPOSES.*

Turning from military and naval applications of electricity to explosive purposes, but few words need be said to recall to the minds of civil engineers the facilities which the employment of electricity as an exploding agent affords for expediting the carrying out of many kinds of work in which they are immediately interested. Electrical blasting, especially when used in combination with rock-boring machines, has revolutionized the operations of tunneling and driving of galleries; and, although in ordinary mining and quarrying operations, the additional cost involved in the employment of fuses and conductors, and the original price of the exploding machine, are not unfrequently of serious consideration, there are, even in those directions, many occasions when the power of firing a number of shots simultaneously is of very great importance. There is little doubt, moreover, that accidents in mining and quarrying would be considerably reduced in number, if electrical blasting were more frequently employed, especially in dangerous mines, instead of the comparatively uncertain system of firing by slow-burning fuse. Many men meet their doom through going up to a shot hole in the false belief that the fuse has burned out, or become extinguished. With electric firing the simplest precautions suffice to insure absolute safety.

A substitute for electrical firing, which possesses considerable merit, and which has been applied with success to the practically simultaneous firing of several charges, claims a passing notice here. It is simply modification of the Bickford fuse, which, instead of burning slowly, flashes rapidly into flame throughout its length, and hence has received the name of instantaneous fuse, the earliest form having been brought from America under the name of lightning fuse. The fuse, as manufactured by Messrs. Bickford, Smith & Co., burns at the rate of about 100 feet per second; it has the general external characteristics and flexibility of the ordinary mining fuse, but is distinguished from the latter by a colored external coating. Numerous lengths of this fuse can be coupled up together in a simple manner, so as to form branches leading to different mines or shot holes, which may be ignited together, so as to fire the holes almost simultaneously. In the navy this fuse is used as a means of firing small gun-cotton charges which may be thrown by hand into boats when these engage each other, the fuse being fired from the attacking boat by means of a small pistol, into the barrel of which the extremity is inserted. In hurried attacks of this nature it would be difficult to deal with wires and electrical exploders.

The conveniences presented by electric-firing arrangements, under special circumstances, are interestingly illustrated by a novel proceeding at the launch of a large screw steamer at Kinghorn, in Scotland, about a year ago. This launch was accomplished by placing small charges of dynamite in the wedge blocks along the sides of the keel, and exploding them in pairs, one on each side of the vessel, hydraulic power being applied at the moment that the last wedges were shot away.

In the deepening of harbors and rivers, and the removal of natural or artificial submerged obstructions, the advantages of electric-firing are so obvious that it is only necessary to refer to them, but this account of the application of electricity as an exploding agent cannot be better concluded than by a brief recital of the most extensive operation of the above kind which has hitherto been carried out, namely, the destruction of the reef of Hallett's Point (Hell Gate), in East River, New York, in September, 1876. The area of rock operated upon, which included all that portion of the reef within the curve of 26 feet below mean low-water, was 3 acres. This space was perforated with forty-one radial tunnels, long and short, and with eleven transverse galleries, leaving as supports to the roof one hundred and seventy-two piers. The aggregate length of tunnels and galleries was 742,567 feet; the amount of rock which had been excavated from these was 49,480 cubic yards; and the time consumed in this work was four years and four months. The work of drilling charge-holes was commenced in June, 1875, and at its completion, in March 1876, five thousand three hundred and seventy-five 3-inch holes had been drilled in the roofs, and in the piers one thousand and eighty 3-inch, and two hundred and eighty-six 2-inch holes; the total length of holes drilled being 58,445 feet. In the earlier portion of the work of excavation powder was used for blasting, but from June, 1872, machine-drills and violent explosives were gradually brought into use. Dittmarr's preparation of nitrated sawdust and nitro-glycerine, known as dualin, and nitro-glycerine alone, manufactured by Mr. Mowbray, were employed experimentally in the earlier operations. In the concluding demolition the explosives used were giant powder, or No. 1 dynamite; rend-rock (the name adopted in America for litho-fracteur); and Vulcan powder, or Vigorite, another nitro-glycerine preparation, which is a mixture of nitrate of soda, sulphur, and charcoal, with about 30 per cent. of nitro-glycerine. A total of 49,914 lbs. of these explosives was used in the single operation. The number of holes charged with these was four thousand four hundred and twenty-seven. The operation of charging occupied nine days. The detonating electric fuses, charged with mercury fulminate, were contained in priming charges weighing ¾ lb. each, inclosed in brass tubes; these were inserted over the charges, which were inclosed in tin cases hermetically closed to exclude access of water. Very simple and effectual means were used for fixing the cases in the holes in the roof of the galleries, etc. The charges were connected in continuous series in groups of twenty, and these again were arranged in divided circuit in eight groups, every group being connected with a distinct carbon zinc battery of forty to forty-four cells. Each battery was thus arranged to explode one hundred and sixty charges. The simultaneous explosion of the complete system of mines was accomplished by a simple circuit-closer, governing the whole of the twenty-three series of charges, which was devised by Julius Striedinger, C. E., who rendered important services in connection with the electrical arrangements.

All was completed by the 23d of September, 1876. Water was admitted to the excavations, which were filled to the level of the tide in seven and a half hours, and the simultaneous explosion of the charges was effected on the following day. The maximum height to which spray was projected by the explosion was 123 feet, the volume of water raised being comparatively trifling, as was also the shock of the explosion. Advantage was taken of this stupendous operation to make observations on the rate of transmission through the earth's crust of an artificially produced impulse analogous to an earthquake; and this work was intrusted to General Abbot, who worked out the formulæ regulating the arrangements of the batteries, fuses and circuits by which the operations were brought to a successful issue. The total amount of rock demolished by the explosion was 63,135 cubic yards. As an illustration of the electric simultaneous explosion of charges, this operation still remains without a parallel, and, though it was obviously impossible to ascertain whether the whole, or what proportion, of the charges had exploded, there appears little doubt, from the completeness of the demolition, that the operation was practically successful over the whole area operated upon. Mr. Striedinger's circuit-closer consisted simply, on the one hand, of a fixed wooden plate or slab fitted with a number of mercury-cups corresponding to the number of firing circuits, one of the wires from each of which being attached to the cups below the plate that supported them; and, on the other hand, of a similar movable plate placed vertically over the fixed plate, and carrying a number of brass pins, corresponding to the mercury cups, and connected with the other branches of the circuit. The latter plate was suspended immediately over the fixed one by a cord, into which a small cartridge was introduced; the explosion of this by an independent battery severed the cord, and allowed the pins to enter the mercury-cups simultaneously.

The outline which has been given of this branch of applied electricity, though unavoidably superficial, will, it is hoped, have conveyed some idea of its history, development and importance, and have also in some measure served to substantiate its claim to rank, if only the last, among the great illustrations which have been brought before you in this course, of the practical benefits resulting from the patient study of science.

*From a lecture by Sir Fred. A. Abel, F.R.S., delivered at the Institution of Civil Engineers.

## THE MISSISSIPPI FLOODS.

The present is the eighth great flood in the Mississippi of which we have authentic accounts. The "big water" in French times was in 1785. In our day the "freshet" of 1844 was the heaviest and the most disastrous, all the tributaries of the Mississippi contributing at the same time to swell the vast volume of the father of waters. Other floods occurred in 1811, 1823, 1826, 1858 and 1881. The first great rise, however, known to white men took place in 1543, while De Soto, the discoverer of the Mississippi, was encamped on its banks near the present site of Helena, Ark.

The first complaint of damage done to white settlers by the overflow of the Mississippi is contained in a petition to the King of France by the people of Kaskaskia, Ill., written in 1725, asking for a grant of land on account of the flood of the previous year. The inhabitants of the village were driven from their homes and took refuge on the adjacent bluffs. The flood of 1844 was still more damaging to the Kaskaskians, who were a second time forced to the highlands. Our honored fellow-citizen, Col. Don Morrison, was a rising young man of Kaskaskia at the time of the latter washout, and abandoned his flooded homestead and went out, like Noah's dove, in search of "land," which he found in abundance.

In 1772 the American bottom was again flooded, and considerable damage was done to the settlers. Fort Chartres, a short distance above Ste. Genevieve, was originally more than half a mile east of the east bank of the river, and the site has almost totally been swallowed up by the encroachments of the river. The year 1785 is known in the annals of the French settlers as *l'annee des grandes eaux*, or the year of the great waters.

The flood of 1811 was quite damaging, and the American bottom was entirely submerged, the settlers in all the towns and farm-houses seeking refuge in St. Louis and on the adjacent hills.

In 1826 the river flooded the whole extent of the bottom, being at its highest about the middle of June. But the flood of 1844 was the most memorable. The preceding winter was comparatively mild, but many heavy snow-storms occurred throughout the northwest. The "spring freshet" commenced the latter part of March, and by the 1st of May the river was bank high; but the water fell without overflowing, and no danger of a flood was apprehended. Heavy rains set in, however, and by the middle of May appearances were threatening. The banks were submerged by the 20th, and the water reached the doors of the stores on the levee north of Pine street. A subsidence followed, and by the 7th of June the river had shrunk to its usual limits at that season. Then the rain storms again set in, and there was a rise in all the rivers. By the 15th the water was again over its banks, and the rise continued for several days, and reached nearly to the mark of 1826. It continued to rise until the 28th, when it commenced falling again, and gradually diminished to its proper compass. While the flood was at its height steamboats were loaded and unloaded from the second stories of stores on the levee, and several fair-sized steamers made excursions from the city to the Illinois bluffs, a distance of ten or twelve miles, passing over the tops of houses in Illinois-town (now East St. Louis).

The damage done by the flood of 1844 was much greater than that of any previous year. At that time the American bottom was becoming settled by small farmers and gardeners, and there was no sign of a levee anywhere to protect their fields and houses. Many of their cabins were swept entirely away by the flood, and it was no unusual sight to see a squatter perched on the roof of his domicile with his dog by his side and a family of chickens near by, floating along at a speed of eight miles an hour. The destitution of that year, however, was a small matter in comparison with the distress that must inevitably follow the present flood. The city council then appropriated $1,000 to the sufferers, and the sum was deemed liberal. It was relatively as much as if the citizens of St. Louis were to donate to present sufferers at least $100,000. The floods of 1851, 1854, 1858, 1863, 1867, 1871, 1875 and 1881 did comparatively little damage, and need not be more than referred to.

The Mississippi below the mouth of the Missouri is always muddy. In the spring time, when the Missouri is on the rise, the Mississippi is swallowed up by its lustier confluent, and becomes a "Big Muddy" to its mouth. The waters carry immense deposits of sand, considerable quantities of which are forced through the jetties of the South pass, and are taken up by the gulf stream and deposited on the Florida keys. Certain scientists maintain the theory that the Mississippi is gradually filling up, and in the course of time will find a new channel for its waters. The bayous of Louisiana are only outlets for the surplus waters of the Mississippi, and, as they are being dammed for plantation purposes, the other outlets are overtaxed, and overflows are becoming more frequent. How long it will take to make the bed of the river dry land, no one can tell.

## EAST ST. LOUIS AND THE FLOODS.

This flood has demonstrated to East St. Louis or certainly should, the great danger the city and railroads are in from the uncertain rises in the Mississippi River, and should teach the city and the railroads the absolute necessity of protection from similar overflows or floods in the future, as they are almost certain to occur periodically. It is held that Bowman's dike ought to be raised five feet at least, and so should the railroad embankments from the Cairo Short Line railroad shops to Venice, and even beyond, and were the dyke and railroad beds raised to above the '44 stage of water, it would be even better, as all possible overflows, so far as are known, would be then provided against. The Ohio & Mississippi railroad bed is several feet above the '44 stage, and that company rested in the most absolute security. Thus, it is held by even railroad officials, all the roads coming into East St. Louis should be situated. It has been held that East St. Louis was the most dangerous locality in the bottoms in times of high water, but in this great emergency, with almost a flood of the stage of 1858, East St.

Louis is almost intact, while all the towns and places above and below are deluged in several feet of water. This state of affairs is attributable only to the Bowman dike and the railroad embankments, for the water in the sloughs pressing against them would if it got in, deluge the city in from five to fifteen feet of water. This was only held out by temporary embankments, and these should now be made permanent, and the danger that has threatened for the past week would in the future be avoided.—*St. Louis Republican.*

## FIFTEENTH ANNUAL CONVENTION, AMERICAN SOCIETY OF CIVIL ENGINEERS.

[Our report of the proceedings of the St. Paul Convention was sadly mutilated in passing through the printers' hands last week, the entire programme of the second, third and fourth days being omitted, although it was forwarded in good time. We give herewith such report as we can reproduce.]

After the election of the Permanent Chairman on Tuesday (see page 303, *ante*), the following letters were read by the Secretary:

A. Manvel, of the St. Paul, Minneapolis & Manitoba Railway, tendered the courtesies of the lines under his management, furnishing transportation in such way as the proper officer of the Society might request. General Manager Haupt, of the Northern Pacific, sent a letter regretting his inability to attend and welcome the members of the Society, and expressing regret, also, because of the fact that he could not tender a free excursion over his road, owing to the difficulty in securing equipment sufficient for the rapidly developing traffic of the road. He tendered the use of a special car, however, which would be attached to any regular train, but advised that not more than one car-load of persons take advantage of the invitation, owing to the limited hotel accommodations at Bismarck and Mandan. An invitation was also extended to visit the new general offices of the road in St. Paul. W. H. Dixon, of the Chicago, Milwaukee & St. Paul, conveyed the offer of General Manager Merrill to return the engineers to Chicago by special train, either by the route they came or via the Dubuque and Sabula, as they might select. E. W. Winter, of the Chicago, St. Paul, Minneapolis & Omaha Railway, tendered an excursion to the Society upon its return to Chicago. R. Angst, Resident Engineer of the Minneapolis & St. Louis Railway, on behalf of Mr. W. H. Truesdale, offered free transportation to the members until Aug. 1, so that they might remain over and view the beauties of the Northwest. H. P. Breed, of the St. Paul & Duluth road, also extended the usual courtesies. William McRoy, President of the Minneapolis, Lyndale & Minnetonka road, also made a similar offer. Major McKenzie, of the Corps of Engineers, U. S. A., tendered the use of the Government steamer General Barnard, for an excursion to Stillwater, via Lake St. Croix; returning, to leave St. Paul for Minnetonka, via Manitoba road. Members who desired to accompany the excursion party were requested to give their names to the Secretary. General Washburn offered the members the privilege of an excursion on Lake Minnetonka, on the steamer City of St. Louis, at the pleasure of the Society. The Engineers' Club at Minneapolis forwarded a communication to the Secretary of the Convention, signed by William A. Pike, inviting the members to accept of their hospitality in being shown points of interest in engineering work in the neighborhood af Minneapolis at any time on the 19th, 20th and 21st. The Local Committee appointed for this special feature were:

On Milling Interests and Water-Power—William De La Barre, chairman.

On City Improvements—Andrew Rinker, chairman.

On City Water-Works—James Waters, chairman.

On Proposed City Parks—S. H. Baker, chairman.

On motion, the thanks of the Convention were returned for all these invitations and courtesies extended by the different companies and persons.

The first paper was then read by Major F. U. Farquhar, U. S. Engineers, on the "Improvement of the Falls of St. Anthony." Major Farquhar gave a history of this important work, its character and cost, the quality of the soil and rock under the falls and along the banks of the river; the difficulties attending the work performed. He commenced with giving a description of the locality and a brief history of what had been done before the Government commenced building the dyke, which had cost $210,729. He next turned his attention to the rolling-dams and aprons, which cost $64,498.72, and concluded by saying that the work of repairing and remodeling the apron was very expensive, and that it will be always a constant expense to keep in efficient condition.

A paper on the "Cost of Steam Power" was next read by Chas. E. Emery, Engineer for N. Y. Steam Heating Co., the discussion of which was, however, postponed, and the Convention adjourned for lunch at the Metropolitan Hotel, furnished by the courtesy of the Local Committee, after which the whole party were taken in carriages and with St. Paul residents as chaperons, were driven to every point of interest in this enterprising and interesting city. At 5 p. m. the party were once more aboard the train, which in good time landed them at their hotel beside the lovely Minnetonka. The evening was spent in conversation, and promenading on the verandas, music and singing in the parlors, and boat riding on the lake.

On Wednesday, June 20, the Convention was called to order at the Capitol Building in St. Paul, at 10:30 a. m., and after the programme for that and succeeding days was again announced by the Secretary, the discussion of Mr. Emery's paper on the "Cost of Steam Power" was taken up, and, in answer to questions by Mr. Francis of Lowell, Mr. Meier of St. Louis and Mr. Holloway of Cleveland, Mr. Emery explained at some length certain portions of his paper in relation to the difference in expense between steam and water power. He said that it was difficult to answer accurately what would be the average time when a complete renewal of steam machinery would be required. There are many engines now in use that have been so for thirty years. The number of boilers are not so great, as they last on an average only about twenty years. In regard to the cost of repairs, taking the above as an average, it is estimated to be about 21 per cent. of the original cost. He had heard a great deal about the improvements in engines, but he questioned if there had been any of importance made. Some novelties had been added and some changes made as to shape, but in the main no great changes had been effected. The item of the cost of fuel mentioned in his paper was based upon facts by actual experiments made at Fall River. In reference to the permanency of water power and its cost for repairs as compared with steam power, Mr. Emery said that upon streams that are intermittent, subject to high and low water, the power was not reliable.

Major Chas. J. Allen, of the U. S. Engineers, now in charge of the work at the Falls of St. Anthony, was then introduced, and made a statement of the present condition of the falls, as follows:

Referring to the able paper of Col. Farquhar, which gave an account of the early proceedings on the part of the citizens of Minneapolis and the Government toward repairing the disasters which followed the attempt to tunnel under the ledge of limestone; the construction of the dyke to prevent percolation through the soft sand-rock; the roller-dams to keep the upper surface of the limestone flooded in order to prevent frost and adhering ice from scaling off the upper surface of the ledge during the winter; Maj. Allen showed that the existence of the falls depended upon the preservation of a ledge of limestone about 1,200 feet in length, and varying in thickness from two feet to sixteen feet, and that the recession of the crest of the falls and consequent integrity of the all-important dyke depended upon maintaining the apron at the foot of the falls in position and repair. The concentration of the flow of the stream into the narrow space of less that 400 feet rendered the maintenance of the apron a difficult matter. The boulder riprapping to protect the toe of the apron, which in 1878 was flush with the water surface, had been by 1882 carried out by the combined action of water and ice, so that for a space of about 120 ft. along the toe of the apron there was a depth of 30 to 84 ft. of water, the soft sand-rock having been scoured out to a depth of perhaps 10 ft. The volume of water passing the falls over the apron having a fall of about 45 ft., was aided in its destructive power by further contraction of the water way, caused by deposits of débris, such as rock, clay and gravel, taken by private parties from an excavation for a mill near by. One of the dumps was 18 ft. in height above low water, and 120 ft. in length. These dumps were placed in the channel above the crest of the falls. Major Allen referred briefly to a large crib or caisson, 80 ft. on a side, sunk during the past winter upon a bed of riprap in the angle to further protect the works, and concluded by saying that about $940,000 had been expended since 1869 or 1870 in preserving the falls, of which about $340,000 was expended by the citizens of Minneapolis, and the rest by the United States Government. In response to a question as to whether the United States Government had improved the falls solely for the purpose of preserving the water power, Major Allen stated that the plea upon which the appropriations were asked, was that the destruction of the falls would be followed by the destruction of the navigability of the river above them.

Dr. Thos. Egleston, of the School of Mines, Columbia College, New York, then read a paper, entitled, "An Accident to Steam Pipes Arising from the Use of Blast Furnace Wool," to some of the statements of which Mr. Chas. E. Emery took exception, but in answer to which Dr. Egleston reasserted that mineral wool under certain circumstances is a dangerous material.

G. Lindenthal, Engineer of the Monongahela Bridge, Pittsburgh, read a paper on the rebuilding of that bridge.*

We give the following abstract of Mr. Lindenthal's interesting paper:

### THE MONONGAHELA BRIDGE.

The last paper read was that by Mr. G. Lindenthal, of Pittsburgh, Pa., upon the rebuilding of the Monongahela Bridge at Pittsburgh, which immense work was completed under his direction. The bridge spans the Monongahela River, connecting Central Pittsburgh with South Pittsburgh. The paper commences by saying that the need of a bridge at this point existed early in the history of the city. A ferry accommodated the travel over the river for a long time. In 1810 a charter for a bridge was obtained, and in 1816 the first structure, a covered wooden bridge of eight spans, 188 ft. each, was built. It consisted of wooden trusses re-enforced with wooden arches—for those days a remarkable engineering success. The superstructure was burnt down in 1845, and was replaced with a wire suspension bridge, of which the engineer was John A. Roebling, who had then just finished a suspension aqueduct across the Allegheny River at Pittsburgh, and this was Mr. Roebling's first road bridge. In time this suspension bridge became very shaky and loose, and its continuous swaying and creaking created anxiety in the public mind. A new bridge was decided upon in the summer of 1880. It was at first decided to build another suspension bridge on a different plan, and work was commenced, but in 1881 the bridge company was reorganized and the new managers desired a different bridge, one that would not be subject to undulations and would be capable of enduring the constantly increasing traffic without limitation of load or speed. It was at this time that Mr. Lindenthal was invited to propose plans for such a bridge, and having done so they were accepted, and he was engaged to carry them out. Having given these historical facts, Mr. Lindenthal then proceeded at length to give a description of the

* See description of Monongahela Suspension Bridge, page 343 *ante*, ENGINEERING NEWS.

material and methods used in the construction of the bridge.

THE MATERIAL.

The masonry consists of a gray, hard and durable sandstone, free from admixture of clay or iron oxide particles. The dimensions of the stones used are 24 to 16 in. in thickness, 7 to 4 ft. in length and from 3 to 1¼ ft. in width, with beds and joints dressed regularly and true. The concrete used throughout the work is composed of two parts of sound broken stone passing through a 3-in. ring; two parts of clean gravel, from the size of a pea to 2 in. in diameter; two parts of washed river sand and one part of Rosendale cement. For concrete under water, two parts of cement were used. The roadway at present is 22 ft. 10 in. wide in the clear, and the two sidewalks are each 10 ft. in the clear. The full width of the bridge on the deck spans approaches is 43 ft. 6 in., and on the channel spans, which are through spans, 48 ft. The bridge can be widened out, if it shall ever be necessary, to 64 ft. It was found that the use of steel, in the trusses at least, would prove economical. The saving in the use of steel over iron, based upon the prices at that time, was over $21,600. After discussing at length the properties of different kinds of steel and iron, the paper gives an account of the method used in removing the old bridge and erecting the new one. The flooring of the roadway and sidewalk consists of preserved wood—namely, gumwood and Ule pine, preserved by the zinc tannin process. The ornamental towers are built of cast iron, the roofs being of wrought iron. The quantities of material used in the construction of the the bridge were as follows: For foundations, lumber, 594,000 ft., board measure; piles, lineal ft., 10,800; concrete, cubic yards, 1,280; iron, tons, 322; stone masonry, cubic yards, 10,500; for superstructure, iron, tons, 1,070; steel, tons, 740; cast iron of towers, pedestals, etc., tons, 196; preserved lumber for floor, 358,000 ft., board measure; steel rails, tons, 134; for approaches, filling, cubic yards, 10,000; sidewalk pavements, square yards, 1,400; street pavements, square yards, 2,200. The length of the bridge is 1,221 ft., and its cost $458,000. The paper concluded with a description of the condition of the material used in the old suspension bridge before removal, and tests with iron from the same, together with the author's conclusions drawn from these tests. The paper, although very lengthy, was listened to with great interest, and drew out some discussion from Messrs. Collingwood and Egleston; but its further discussion was postponed until the printed copies had been issued to members. The Convention then adjourned. The ladies of the party who had come to St. Paul in the morning had been entertained by a drive through the city and to all interesting points. The Convention lunched at the Union depot, and immediately thereafter returned to Lake Minnetonka to prepare for the excursion on the lake tendered by Governor Washburn. The weather and railway accident intervened, however, and the evening was spent after the usual manner at watering-place hotels.

During the day and evening the Souvenir Book of the Convention was distributed. It is a beautiful book, bound in full Turkey morocco, handsomely embossed on each side with the words St. Paul and Minneapolis in heavy gold letters. Its contents consist of fifteen photo-engravings of prominent buildings, bridges and street views in each city. Each alternate page contains a condensed history of the two cities, descriptive notes and statistics of their manufactures, railroad facilities, commercial advantages, improvements, growth, etc. These pages are printed on fine plate paper, with carmine border lines and initial letters, altogether forming a beautiful souvenir fit to grace the parlor table of any home in the land. The design and finishing of this work was placed by the committee in the hands of Messrs. J. A. Wheelock of St. Paul and W. S. King, of Minneapolis, and the result of their labors will no doubt be duly appreciated and carefully treasured by the members of the Society.

On Thursday, June 21, the Convention was called to order at 11:25 a. m. in the Capitol Building at St. Paul. The programme for the day was read, and invitations tendering the courtesies of the Canadian Pacific and the Wisconsin Central railroads. The first paper read was by J. P. Frizzell, C. E., of St. Paul, upon the "Water Power of St. Anthony Falls," which is too long to be reproduced here.

Capt. O. E. Michaelis of the U. S. Ordnance Department read an interesting illustrated paper entitled. "First, Metrological Investigations; second. The Determination of Minute Heliacal Errors in Measuring Levers; third, A Suggestion for the Elimination of Personal Aberration in Block Signaling."

D. J. Whittemore, Chief Engineer Chicago, Milwaukee & St. Paul Ry., read a paper on "The Use of the Nasmyth Steam Pile Driver," giving the results of its use on the foundations of the La Crosse and Sabula Bridges and illustrated by a specimen of the head of a pile driven at Sabula, which had been sawed off just below the ring support.

A paper by G. P. Stearns, of Boston, Mass., on the "Current Meter," together with a Reason why the Maximum Velocity of Water Flowing in Open Channels is Below the Surface," was also read in another room, in the presence of such members as were particularly interested. On account of the delay in getting to St. Paul in the morning, the meeting for reading papers had to be closed here, and the paper by J. W. Putnam, "On the Cause of Decay in Timber," was read only by title.

A paper by Benjamin Reece on "Track Repairs," was read by title. (See page 307 *ante*.)

A business meeting was then held, Mr. J. J. R. Croes, of New York, being called to the chair, and the following gentleman being elected nominating committee for the ensuing year: D. C. Shepard, St. Paul, for the Northwest division; Charles Hermany, Louisville, for the Southwest division; C. C. Martin, New York, for the New York and Pennsylvania division; F. Slataper, Philadelphia, for the Middle division; A. Fteley, Boston, for the Eastern division, The committees on Uniform Tests of Cement and on the Preservation of Timber were granted further time to report. The committee appointed to procure aid from Congress to carry on the tests of iron and steel reported progress and was continued.

THANKS FOR COURTESIES.

Mr. W. P. Shinn of New York then offered the following resolution of thanks, which was adopted unanimously by a standing vote:

The American Society of Civil Engineers, as represented in its fifteenth annual convention by the largest attendance yet had at any of its conventions, desires to express its appreciation of the facilities furnished and courtesies extended for the edification and entertainment of the members and ladies accompanying them, who hereby place upon record their appreciation thereof, and tender their sincerest thanks

To the Engineers' Club of the Northwest, for courtesies extended during the stay at Chicago.

To the Chicago, Milwaukee & St. Paul Railway Company and the St. Paul, Minneapolis & Manitoba Railway Company and their officers, for the special trains and unusual facilities afforded by them.

To the Chicago & Northwestern Railway Company, Canadian Pacific Railway Company, Minneapolis & St. Louis Railway Company, St. Paul & Duluth Railway Company, Chicago, St. Paul, Minneapolis & Omaha Railway Company, Minneapolis, Lyndale & Minnetonka Railway Company, the Wisconsin Central Railway Company, for the transportation so freely and courteously offered.

To the local committees of St. Paul and Minneapolis, for the complete arrangements made by them for making our visit agreeable and instructive.

To the Governor of the State of Minnesota and the Mayors of St. Paul and Minneapolis, for their kind expressions of the welcome so generously extended by the citizens of the two cities.

To Gen. W. D. Washburn, for the excursion so generously tendered us on Lake Minnetonka.

To the chairman, Mr. D. C. Shepard, for his services in presiding over our deliberations, realizing as we do that in the great Northwest, especially, time is money.

And to the reporters of the city press, for the full and fair reports of the proceedings of the Convention. Therefore,

*Resolved*, That the secretary of the society be and he is hereby instructed to forward to all the parties named, and to all others to whom we are indebted for courtesies and facilities, suitably engrossed expression of our thanks for their courtesy.

Permanent Chairman Shepard thanked the Convention for the courtesies shown him as its presiding officer, and on behalf of the citizens of St. Paul expressed the hope that their further stay in Minnesota would be pleasant, and that their future lives would be prosperous and happy; and then declared the Convention in St. Paul adjourned.

For continuation of this day's programme see page 303 *ante*, 3d paragraph, 3d column, giving account of excursion to Ft. Snelling and Minnehaha Falls, and the steamboat excursion in the evening. The afternoon and evening were the most enjoyable of the Convention, especially the Lake Minnetonka excursion, which furnished a delightful interval of genuine rest after so much fatiguing railway experience.

On Friday, June 22, the party were taken by steamer across Lake Minnetonka to Excelsior, where they were transferred to the open cars of the Minneapolis, Lyndale & Minnetonka Railway (narrow gauge), or motor line, as it is called, by which route they were conveyed to within one block of the Minneapolis Opera-House, where, after all were comfortable seated in the parquette and dress circle, at 10:30 a. m. Secretary Bogart introduced Gen. C. F. Hatch as the presiding officer of the Society for the occasion.

Gen. Hatch responded with a cordial welcome to the engineers to the city of Minneapolis, and hoped the visit would be remembered with such pleasure as to insure frequent repetitions in the future.

Ex-Mayor A. C. Rand was then called upon to address the visitors in behalf of the city, and responded in substance as follows:

"By the absence of the Mayor, the pleasant duty devolves upon me to extend to you the entire freedom of the city with all that the term implies. Minneapolis feels honored by the presence of a delegation like this, and the hearts of our people thrill responsive to all honorable strangers who may call upon them."

Mr. Rand paid a high compliment to the engineers as a body, adding:

"Through the brains of one of your number, Col. Farquhar, this city is much indebted to you for its present prosperity."

Reverting to the possible disasters from the weather, which he felt confident would yet be averted, Mr. Rand closed with the words, "Again and again, I welcome you."

His happy welcome was warmly applauded.

Gen. Hatch then introduced Mr. Metcalf, of Pittsburgh, who had been selected to deliver the annual address of the president of the Society, in the absence of President Paine.

We had anticipated, Mr. Metcalf said, a review of the engineering progress of the year, and that being impossible, we will briefly review the progress of engineering along the Mississippi River and our more immediate surroundings, now visited by many for the first time. Eastern people were disposed to regard this as a new country, but we find here every indication of progress and advancement.

Mr. Metcalf then reverted to the gradual movement of the human race in the early ages from the east westward, and from the lessons of the past drew the conclusion that there were engineers even in those remote days—men of action and men of brains. He next spoke of the topographical and other peculiarities of the West, as described by Gen. Custer and others—beauty everywhere.

But, he continued, the wildness has gone. The mighty railway kings of the West have given us free passes to the country beyond. Yet we rub our

eyes and ask ourselves unconsciously, "Where are we?" The track of the buffalo is obliterated by the tracks of the iron horse, and even poetical Minnehaha has given way to the laughter of the fair daughters of earth. We are in the heart of a continent from whence flows the life blood of a great nation.

The mutual relations of different communities were next eloquently portrayed, especially the effects of good crops in the Northwest upon trade and manufactures in every portion of the country.

But we must confine our attention to the engineering work we have come to see, more particularly along this great river. In the South we have Eads' jetty system opening a way for the traffic of the world. The levee system, the St. Louis steel arch bridge, interesting monuments of engineering skill; the Rock Island Arsenal, safe in the midst of a happy people, and the improvements of the river for the benefit of navigation were mentioned as the benificent achievements of the engineers, which extend even here into the breathing place of two great cities, one devoted to commerce and the other prepared to furnish the world with bread, and in the contemplation of whose splendid hospitality we are lost in a halo of happiness.

Mr. Metcalf, in conclusion, predicted that the shores of Minnetonka are destined to become the park of the world, and promised an inspection of the great powers of the falls and the triumphs here attained through engineering skill. The importance of ascertaining the mutual duties and interests of Western engineers were referred to, and Mr. Metcalf assured his hearers that the meeting today will always be held in happiest remembrance.

The paper for the day was by Mr. W. P. Shinn, upon the question "How Can Railways be Made More Efficient in the Transportation of Freight?" which is a sequel to the now quite celebrated paper of Mr. Shinn on "The Increased Efficiency of Railways for the Transportation of Freight," and for the full text of which our readers are referred to the published Transactions of the Society, as any abstract of these papers will fail to do justice to them.

At 12:30 the party were taken by the motor line to Lake Calhoun, where a bountiful lunch had been provided by the generous Minneapolis hosts, after which carriages were taken, and the party shown all the interesting features of the city of Minneapolis, until 5:30, when the train on the Minneapolis & St. Louis R. R. conveyed them to Lake Minnetonka and their hotel.

The banquet given in the evening is described heretofore, also the excursion of Saturday.

Thus closed the 15th annual convention of the Society. It will always be remembered with pleasure by those who attended it, for the new and interesting portions of this great country and its busy industries brought to their acquaintance, and for the exceedingly generous courtesies of the warm-hearted and enterprising hosts by whom the visitors were so magnificently entertained.

## LIST OF MEMBERS AND VISITORS AT THE ST PAUL CONVENTION.

We give herewith as complete a list of members and guests as it has been possible to obtain from the Secretary's lists, from the hotel register, the newspaper lists and from general acquaintance and inquiry. After all we expect that some are omitted, especially the names of lady visitors, many of whom were not registered on the hotel books, many incorrectly, and none in the Secretary's list. It is a source of satisfaction to know just who constituted the pleasant company who meet at these annual conventions, and we regret the as yet unorganized method of obtaining a full and accurate list. We hope in future to devise a plan by which such will be obtained.

James Archbald, Chief Engineer D., L. & W. R. R., Scranton, Pa.

Edward R. Andrews, Proprietor Old Dominion Creosoting Works at Norfolk, Va.; Miss Andrews, and Miss Mary Andrews, New York City.

John B. Atkinson, Secty. and Treas. St Bernard Coal Co., Earlington, Ky.

T. S. Abbott, C. E. Mexican National Construction Co., Monterey, Mex.

William M. Allaire, Engineer U. S. Electric Lighting Co., New York City.

Thomas Appleton, Asst. Engr. Topeka, Salina & Western R. R., Council Grove, Kan.

A. V. Abbott, Engineer Dept. of Tests and Experiments, New York City.

Henry G. Bliss, C. E., La Crosse, Wis.

A. Borodin, Engineer-in-Chief Russian S. W. R. R., Kieff, Russia.

Geo. Burnett, C. E., St. Louis, Mo.

T. C. Bradley, C. E., Cookson Iron Works Co., Kansas City, Mo.

William H. Bradley, C. E., and Mrs. Bradley, Boston, Mass.

Geo. Burnett, Jr., C. E. Sewer Dept., St. Louis, Mo.

W. R. Belknap, C. E., and Mrs. Belknap, Louisville, Ky.

H. R. Bradbury, Manager Neuchatel Asphalte Co., and Mrs. Bradbury, New York City.

Max Becker, Chief Engineer P. C. & St. L. R. R.; Mrs. Becker and Miss Becker, Columbus, O.

J. D. Burr, C. E., Topeka, Kan.

Onward Bates, President Pittsburgh Bridge Co., and Miss Bates, Pittsburgh, Pa.

Charles Blackwell, Supt. Motive Power Norfolk & Western and Shenandoah Valley R. R., and Mrs. Blackwell, Roanoke, Va.

Arthur Beardsley, Professor of Mechanics and Engineering, Swarthmore College, and Mrs. Beardsley, Swarthmore, Pa.

John Bogart, *Secretary* American Society of Civil Engineers, and Mrs. Bogart, New York City;

John H. Bogart, New York City.

Daniel Bontecou, C. E., Kansas City, Mo.

A. H. Blaisdell, Western Iron Boat Building Co., So. St. Louis, Mo.

William H. Burr, Professor of Mechanics, Rensselaer Polytechnic Institute, Troy, N. Y.

E. C. Burns, U. S. Asst. Engineer, Sault Ste. Marie.

Cabel Breckinridge, Engineer Ala. Grt. Southern and V. & M. R. Rs., Tuskaloosa, Ala.

J. F. Barnard, Gen. Supt. K. C., St. Jo. & C. B. R. R., and Miss Barnard, St. Joseph, Mo.

J. W. Bishop, St. Paul, Minn.

William H. Bixby, Captain of Engineers U. S. A., Willett's Point, N. Y. Harbor.

Andrew Bell, Resident Engineer, Carillon Canal, Carillon, Quebec.

Geo. H. Beuzenberg, City Engineer, Milwaukee, Wis.

C. H. Crandall, Assist. Prof. Civil Engineering, Cornell University, Mrs. Crandall and cousin, Ithaca, N. Y.

Francis Collingwood, Asst. Engineer East River Bridge, Mrs. Collingwood and Miss Burnett, New York City.

Robert Cartwright, Mech. Eng., Rochester, N. Y.

Martin Coryell, C. E., and Mrs. Coryell, Lambertville, N. J.

J. James R. Croes, *Treasurer* Am. Soc. C. E., and Miss Croes, New York City.

David W. Cunningham, C. E., and Miss Cunningham, Grandin, Dakota.

Augustin P. Clarke, C. E., and Mrs. Clarke, Cazenovia, N. Y.

A. G. Compton, Prof. of Applied Mathematics, College of City of New York, Mrs. Compton and Miss Compton, New York City.

Col. William Crooks, St. Paul, Minn.

M. Cowles, Proprietor *American Engineer*, Mrs. Cowles and sister, Chicago, Ill.

Chas. Davis, County Engineer, Pittsburgh, Pa.

E. A. Doane, C. E., Meadville, Pa.

Geo. C. Duane, Colonel of Engineers U. S. A., Tompkinsville, N. Y.

A. Dempster, C. E., Pittsburgh, Pa.

Chester B. Davis, Hydraulic and Sanitary Engineer, and Mrs. Davis, Chicago, Ill.

Joseph P. Davis, Vice President and Chief Engineer Metropolitan Telephone Co., and sister, New York City.

Chas. E. Emery, Engineer N. Y. Steam Heating Co., Mrs. Emery and son, New York City.

N. M. Edwards, Engineer Green Bay & Mississippi Canal Co.; Mrs. Edwards and Miss Nellie P. Ballard, Appleton, Miss.

Howard N. Elmer, C. E., St. Paul, Minn.

M. T. Endicott, Civil Engineer U. S. Navy, U. S. Navy Yard Philadelphia, Pa.

Geo. D. Emerson, C. E., Rolla, Mo.

Prof. T. Egleston, Engineer of Mines, Columbia College, New York.

Francis N. Farquhar, Major of Engineers, U. S. A., Detroit, Mich.

Robert Fletcher, Professor of Civil Engineering, Dartmouth College, and Mrs. Fletcher, Hanover, N. H.

C. G. Force, Jr., C. E., Cleveland, O.

James B. Francis, *Past President* American Soc. C. E., Chief Engineer and Agent for the Proprietors of Locks and Canals, and Mrs. Francis, Lowell, Mass.

Geo. H. Frost, ENGINEERING NEWS AND AMERICAN CONTRACT JOURNAL, Mrs. Frost, New York City, and Miss Amy Hunt, Chicago, Ill.

Clark Fisher, C. E., and sister, Trenton, N. J.

Edward A. Flint, C. E., Boston, Mass.

John R. Freeman, Prin. Asst. Engr. Essex Water Power Co., Lawrence, Mass.

Jos. P. Frizell, C. E., St. Paul, Minn.

F. N. Finney, Ch. Engr. and Gen. Manager Wisconsin Central R. R., Milwaukee, Wis.

T. L. Frazier, Asst. Engr. L., N. A. & St. L. R. R., Louisville, Ky.

A. Fteley, First Asst. City Engineer, Boston, Mass., and Mrs. Fteley.

Chas. E. Greene, Professor of Civil Engineering, University of Michigan, Ann Arbor, Mich.

Chas. E. Goad, C. E., and Mrs. Goad, Montreal, Canada.

Frederick Graff, Consulting and Hydraulic Engineer, and Mrs. Graff, Philadelphia, Pa.

Samuel M. Gray, City Engineer, Providence, R. I.; Mrs. Gray and sister.

George S. Greene, Jr., Chief Engineer Dock Department, New York City.

Gen. N. Gleason and Miss Gleason, La Porte, Ind.

Christopher L. Gates, Engineer Milwaukee Bridge and Iron Works, Milwaukee, Wis.

J. L. Gillespie, U. S. Engineers, St. Paul, Minn.

S. S. Greeley, City Surveyor, Chicago, Ill.

James H. Harlow, Engineer Monongahela Navigation Co., and Mrs. Harlow, Pittsburgh, Pa.

Horace E. Horton, Bridge Builder, and Mrs. Horton, Rochester, Minn.

William M. Hughes, Bridge Engineer, "Nickel Plate" R. R., and Mrs. Hughes, Cleveland, O.

Rudolph Hering, Sanitary Engineer, and Mrs. Hering, New York City, and Mrs. H. G. Barnhurst, Erie, Pa.

Chas. Hermany, Chief Engineer Water-Works, and Mrs. Hermany, Louisville, Ky.

William P. Harris, Div. Supt. Ches. & Ohio R. R., and Mrs. Harris, White Sulphur Springs, W. Va.

W. S. Huntingdon, Pres. Dartmouth National Bank, and Mrs. Huntingdon, Hanover, N. H.

M. E. Howe, Engineer and Supt. H. & T. C. R. R., and Mrs. Howe, Houston, Tex.

W. A. Haven, C. E., Buffalo, N. Y.

Fred. B. Howard, Ch. Engr. P. O. & P. A. R. R., Detroit, Mich.

Henry Harding, C. E., Salem, Mass.

J. F. Holloway, President Civil Engineers' Club, Cleveland, O.

Randell Hunt, City Engineer, and Mrs. Hunt, Fargo, Dak.

S. A. Harrison, Supt. Water-Works, Mrs. Harrison and sister, Stillwater, Minn.

Wm. H. Jennings, Ch. Engineer, C., H. V. & T. R. R., Columbus, O.

M. W. Kingsley, Asst. Engineer and Supt. Water-Works, Cleveland, O.

L. M. Johnson, Asst. to President Pullman Palace Car Co., and Mrs. Johnson, Chicago, Ill.

Wm. B. Knight, City Engineer, Kansas City, Mo.

Fr. Langé, Engineer Attaché German Legation, Washington, D. C.

Chas. King, Captain U. S. A., Milwaukee, Wis.
Thos. D. Lovett, Consulting Engineer, Cincinnati, O.
D. Jones Lucas, Asst. Engineer Maintenance of Way, P. & L. E. R. R., Lowellsville, O.
Chas. F. Loweth, C. E., St. Paul, Minn.
G. Lindenthal, Ch. Engineer Monongahela Bridge, and Mrs. Lindenthal, Pittsburgh, Pa.
John Lawler, President Pairie du Chien & McGregor, R. R., Prairie du Chien, Wis.
Thos. B. Lee, Ch. Clerk Am. Soc. C. E., and Mrs. Lee, New York City.
Wm. H. Lotz, Mech. Eng., Mrs. Lotz and sister, Chicago, Ill.
O. E. Michaelis, Captain of Ordnance, Frankford Arsenal, Philadelphia, Penn.
B. F. Morse, City Engineer, Cleveland, O.
Jas. MacNaughton, of Osgood & MacNaughton, Albany, N. Y.
Marshall Morris, C. E., Louisville, Ky.
Henry G. Morris, President Engineers' Club, Philadelphia. Mrs. Morris and son, Philadelphia, Pa.
R. C. Morris, C. E., Nashville, Tenn.
Thos. C. McCollum, Civil Engineer U. S. Navy, Boston, Mass.
T. H. McKenzie, Ch. Engineer Water-Works, Southington, Conn.
G. W. McNulty, Asst. Engineer East River Bridge, Brooklyn, N. Y.
Chas. H. Myers, Asst. Engineer in Charge of Sewers, N. Y. City.
Robt. E. McMath, U. S. Asst. Engr., and son, St. Louis, Mo.
J. J. McVean, Ch. Engr. D., L. & N. R. R., Ionia, Mich.
Robt. Moore, Chief Engr. St. L., A. & S. H. R. R., St. Louis, Mo.
H. C. Moore, Prest. St. Louis Engineers' Club, St. Louis, Mo.
L. P. Morehouse, Engineer Ill. Central R. R., and Miss Morehouse, Chicago, Ill.
W. H. McClintock, Supt. Road Dept. L. & N. R. R., Louisville, Tenn.
Henry G. Morse, Morse Bridge Co., Youngstown, O.
John McLeod, Gen. Supt. L., N. & C. R. R., and Mrs. McLeod, Louisville, Ky.
David E. McComb, Asst. Engr., Washington, D. C.
William Metcalf, of Miller, Metcalf & Parkin, and Mrs. Metcalf, Pittsburgh, Pa.
E. D. Meier, C. E., and Mrs. Meier, St. Louis, Mo.
T. C. Meyer, C. E., New York City.
C. MacRitchie, C. E., Chicago, Ill.
R. Miller, C. E., and Mrs. Miller. Pittsburgh, Pa.
A. McKenzie, Major of Engineers, and Mrs. McKenzie, St. Paul.
F. O. Norton and Mrs. Norton, New York City.
R. M. Newman, Jamestown, Dak.
S. B. Opdyke, Jr., Engineer Maintenance of Way N. H. & N. R. R., New Haven, Ct.
J. A. Ockerson, U. S. Asst. Engineer, and Mrs. Ockerson, St. Louis, Mo.
Edward Prince, Engineer Water-Works; Mrs. Prince and daughter, Quincy, Ill.
Geo. H. Pegram, Engineer of Bridges and Buildings, Edgemoor Iron Co., and Miss Pegram, Wilmington, Del.
Franklin C. Prindle, Civil Engineer U. S. Navy, Mrs. Prindle and Miss Prindle, Brooklyn, N. Y.
P. A. Peterson, Chief Engineer Atlantic & Northwestern R. R., Montreal, Canada.
John A. Partridge, late Div. Engineer N. Y., W. S. & B. R. R., Syracuse, N. Y.
Chas. J. Peetsch, Asst. City Engineer, and Mrs. Peetsch, Milwaukee, Wis.
P. H. Philbrick, Professor of Civil Engineering, Iowa University, and Mrs. Philbrick, Iowa City, Ia.
Mrs. Washington A. Roebling and son, Brooklyn, N. Y.
H. B. Richardson, Chief State Engineer, New Orleans, La.
Benjamin Rhodes, Civil Engineer, Niagara Falls, N. Y.
H. E. Stevens, C. E., St. Paul.
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William H. Searles, C. E., and Mrs. Searles, Cleveland, O.
F. P. Stearns, Asst. Engineer Boston Improved Sewerage, Boston, Mass.
D. McN. Stauffer, ENGINEERING NEWS AND AMERICAN CONTRACT JOURNAL, New York City.
Geo. F. Swain, Asst. Professor Civil Engineering, Mass. Inst. of Technology, Boston, Mass.
R. P. Staats, First Asst. Engineer Erie Ry., New York City.
Chas. C. Smith, Ch. Engineer, St. P., M. & M. R. R., St. Paul, Minn.
William P. Shinn, Vice-President, N. Y. Steam Heating Co., and Mrs. Shinn, New York City, and Miss Molly Farley and Miss Lu Farley, Pittsburgh, Pa.
Jared A. Smith, Major of Engineers, U. S. A., Indianapolis, Ind.
Robt. A. Shailer, Engineer of Bridges and Buildings Chi., Mil. & St. P. Ry., and Mrs. Shailer, Milwaukee, Wis.
D. C. Shepard, of Shepard & Langdon, Contractors, St. Paul, Minn.
F. Slataper, Chief Engineer Penna. Co., and Miss Slataper, Pittsburgh, Pa.
Gen. W. Sooy Smith, C. E., Mrs. Smith and cousin, Chicago, Ill.
C. Shaler Smith, Consulting Engineer, Mrs. Smith and daughter, St. Louis, Mo.
J. S. Sewall, C. E., St. Paul, Minn.
W. T. Taylor, C. E., Chester, N. J.
A. W. Trotter, C. E., and mother, New York City.
Capt. E. D. N. Talcott, Principal Morgan Park Military School, Morgan Park, Ill.
Gilman Trafton, Engineer Louisville Bridge and Iron Co., Louisville, Ky.
J. G. Van Horne, C. E., Jersey City, N. J.
F. W. Vaughan, Consulting Engineer, L. & N. R. R., Louisville, Ky.
John D. Van Buren, N. Y. State Engineer's office, and Mrs. Van Buren, Albany, N. Y.
William H. Wiley, publisher, Mrs. Wiley and Miss Wiley, New York City.
Charles Wiley and cousin, Orange, N. J.
S. Whinery, Div. Engineer N. O. & N. E. R. R., Meridian, Miss.
D. W. Wellman, U. S. Asst. Engineer in charge of Missouri River Surveys, and Mrs. Wellman, St. Louis, Mo.
O. B. Wheeler, C. E., Detroit, Mich.
Geo. Y. Wisner, C. E., Detroit, Mich.
Fr. Mor. Wolff, Ph. D. and Royal Mining Engineer, Berlin, Germany.
Geo. H. White, Res. Engineer C. M. & St. P. Ry., Minneapolis, Minn.
John W. Weston, *American Engineer*, and Mrs. Weston, Chicago, Ill.
W. W. Walker, President and Gen. Supt. St. L., H. & K. R. R., and Mrs. Walker, Hannibal, Mo.
D. J. Whittemore, Chief Engineer C., M. & St. P. Ry., and Mrs. Whittemore, Milwaukee, Wis.
Wm. H. Woodyard, Asst. to Secretary A. Soc. C. E.

BRIDGES ON THE LONG BRANCH R. R.—It having been reported that the bridges of the Central of N. J. on the road to Long Branch are unsafe, President Little of that road says: "As to the bridges, they are absolutely safe. They are built of the best material, and are constructed skillfully. This railroad has been in operation twenty years, and not an accident has happened in consequence of the faulty condition of any bridge. The accident at Parker's bridge, at which life was lost, was not in consequence of the condition of the bridge, but of the track. Since the arbitrators' unfavorable report has been made an expert has examined all of the bridges on the line of the railroad, and he reports that they are in a perfectly safe condition for any amount of travel."

## THE THIRTY-SECOND MEETING OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

TO BE HELD AT MINNEAPOLIS, MINNESOTA, AUGUST 15–21, 1883.

The Association will be called to order, in General Session, at 10 o'clock on Wednesday morning, August 14, by President J. W. Dawson, of Montreal, who will resign the chair to the President elect, Professor C. A. Young, of Princeton.

The headquarters of the Association will be at the State University, where members will register as soon as possible after arrival. The hotel headquarters of the Permanent Secretary will be at the Nicollet House.

The Standing Committee will meet at the Nicollet House on Tuesday morning, August 14, at 11 o'clock.

Members expecting to attend are requested to notify the Local Secretary, Prof. N. H. Winchell, Minneapolis, Minn., as early as possible.

The circular of the Local Committee will soon be issued, and will contain information relating to the arrangements made for the meeting, hotel accommodations, transportation and other matters of importance.

All communications relating to local matters and transportation must be addressed to the Chairman of the proper Sub-Committee at Minneapolis.

All matters relating to membership, the presentation of papers, and business to come before the Association will be attended to by the Permanent Secretary at his office in Salem, Mass., up to August 8. After this date and until the meeting has adjourned the address of the Permanent Secretary will be the Nicollet House, Minneapolis.

*Local Committee for the Minneapolis Meeting.*

Chairman, Hon. George A. Pillsbury.
Secretary, Prof. N. H. Winchell.
Treasurer, Hon. George A. Pillsbury.
Sub-Committee on Invitations and Receptions. Chairman—President W. W. Folwell.
Sub-Committee on Finance. Chairman—J. C. Seeley, Esq.
Sub-Committee on Transportations and Excursions. Chairman—Thomas Lowry, Esq.
Sub-Committee on Entertainment, Hotels, Lodgings and Luncheons. Chairman—Hon. A. C. Rand.
Sub-Committee on Room and Places of Meeting. Chairman—Hon. Eugene M. Wilson.
Sub-Committee on Printing. Chairman—David Blakely, Esq.
General Committee.—Hon. George A. Brackett; Hon. A. C. Rand; Hon. John De Laittre; Ex-Gov. Jonn S. Pillsbury; W. W. McNair, Esq; Dr. Wm. W. Folwell; Charles W. Johnson; Gen. A. B. Nettleton; Hon. W. W. Washburn; T. B. Walker; Hon. O. C. Merriman; E. V. White; Hon. H. T. Welles; Col. H. G. Hicks; Thomas Lowry, Esq.; Winthrop Young; Hon. W. S. King; David Blakely; Hon. R. B. Langdon; Hon D. L. Kiehle; J. C. Seeley, Esq.; Anthony Kelly; Dr. A. F. Elliott; Hon. F. W. Brooks; Hon. Eugene M. Wilson.

THE PEOPLE'S RAILWAY.—Persons who have read the prospectus of the so-called "People's Railway," and have heard the arguments of the promoters of this remarkable scheme, declare that there is a strong flavor of the defunct Greenback Party about the project. The truth is that those who are trying to induce the citizens of Indianapolis to loan money to be used in building a double-track narrow-gauge railway from New York to San Francisco, and another from Chicago to New Orleans, are simply attempting to galvanize into life a scheme that was proposed by Greenbackers in Congress, and that died in that body. The introduction of bills for the construction of a so-called anti-monopoly railway from New York to San Francisco has been one of the favorite pastimes of Greenback Congressmen, and the Government has cheerfully printed the bills which they have prepared from time to time. The most amusing feature of the scheme recently proposed in Indianapolis is the part assigned by the promoters to "California capitalists." We are told that these capitalists stand ready to put in $90,000,000 as soon as the people have subscribed $10,000,000, or that these capitalists will contribute as much additional money as may be needed for the construction of the first section of the road from Indianapolis to San Francisco. But this is to be a people's railway an anti-monopoly railway. And for the purpose of firmly establishing its anti-monopoly character, its managers are to allow the great capitalists of California, the most persistent and successful railway monopolists in the world, to hold nine-tenths of the stock? There are the elements of a colossal joke in this "stupendous enterprise."—*N. Y. Times.*

LIEUT. DAN C. KINGMAN, of the Corps of Engineers, will not report at Willett's Point, but remain for the present as Engineer Officer Department of the Platte.

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AMONG the most noticeable features of St. Paul and Minneapolis is the almost total want of public improvements. In Minneapolis there has not been a paved street until this season, when a great deal of street improvement is under way, and in St. Paul it is about the same. Each city covers a very large territory on account of the size of residence lots and the universality of homes. The streets are now simply "dirt roads," very dusty or very muddy during the few months of warm weather. These two enterprising cities are really just entering upon an era of public improvements, and it looks as though, to an enterprising sewer or paving contractor, with abundant capital and improved plant, a chance to make some money exists in these cities. We noticed, especially in Minneapolis, that the whole of a street was taken up by the sewer contractor, and we were told that the trenches remained open apparently much longer than was necessary. A few of Carson's excavating machines would relieve the streets of Minneapolis very materially.

The English continue to greatly mistrust the expediency of the Channel tunnel. Sir Frederick Abel has been again giving his views on explosives before the Joint Committee of the two Houses of Parliament. He asserted that it would be easy to destroy the tunnel; but he had also to acknowledge that "explosions that were intended did not happen on some occasions."

An English paper makes the following objections:

Apart from the question whether the explosion would go off when wanted lies the question whether they would not be likely to go off when not wanted to do so.

It would be necessary to at all times keep the destroying agents in a position ready for immediate local use. The knowledge of this would be pleasant for travelers who used the tunnel. Notices intimating that large quantities of explosives were placed along the submarine route might be placed at each end of the bore.

But, seriously, is it wise to introduce into one's garden that which one has to surround with the utmost precaution to prevent harm-doing?

At present we are not free from alarms at every trouble or prospect of war on the Continent. The tunnel once made, there will be continual outcry about precautionary measures of defense. The invasionist fears will lead to increased armament and increased taxation to keep it up.

But a tunnel once made and in use as great as the promoters desire, there would be a call for another piercing. Submarine communication would no more stop at one tunnel than we have stopped at one Atlantic cable. We are just as likely to be confined to one Suez Canal as we are likely to be kept to one channel tunnel.

If it were contended, by and by, that it would be unwise to multiply our risks from submarine routes, there would be a great outcry about monopoly. It may, indeed, be questioned whether the proprietors of any one tunnel would be so wise in their management thereof as to lead to no dissatisfaction among its users.

## RAILROAD BUILDING AT HOME AND ABROAD.

It is very evident that England, France and Germany are to-day suffering from what may be termed a financial hypertrophy—from a lack of good investments for capital. The great crisis of 1873 has never been entirely eliminated in Europe; there at least a certain condition of things has arisen that bids fair to be permanent unless two great factors come into play, viz.: an immense emigration of population, or a great outflow of capital. The good news that is now and then telegraphed from the London and Paris markets can by no means counterbalance the fact that profitable and sure investments are scarce, and that, in fact, there has not and there cannot be anything like the progression of earning that would be requisite for the increase of population.

What has hitherto saved England from the natural effects of a money plethora and an industrial anaemia is this: She has maintained a world-wide trade; her mercantile marine is everywhere; the change from sailing to steam vessels has inured to her advantage. She has invested largely not only in her colonies but in every clime from "China to Peru." She has no duties on raw materials to hamper manufacture and trade, and her merchants and contractors keep an eye on what is going on in the world, and extend their operations on all sides.

But, while this has prevented any catastrophe in England, and may continue to do so, as far as that country is concerned, there is no denying the fact that the financial and industrial situation in Europe is not at all promising. We need not go into the intensely depressing effects of standing armies, of immense and continually growing national debts, of a feudal condition of land. There are in addition to these a great industrial fact that is often overlooked: the great railway age of 1848 is past—"the pleasant days of Aranjuez are now over."

The countries, except Russia, are griddled with roads, the water-works are all made; gas works are everywhere (and electricity is not going to be its financial successor), and other "modern improvements" have been placed in every quarter where there was the slightest prospect of their being a pecuniary success. So far as these three great countries are concerned, it may be said that the home employment of capital has about reached its limit. A glance at London financial papers will show the most outlandish schemes not at all unworthy of figuring alongside the "Hot Muffin and Punctual Delivery Company" of Dickens. The railway building age began in 1848, and came in very opportunely to absorb the then redundant capital. Reybaud, in his "*Jerome Parturof à la recherché d'une position sociale*," describes the extraordinary schemes then in the Paris market, where "bitumen" companies were most in favor.

Even a few years ago, the French government of the time appreciated the state of affairs and contemplated the execution of a vast scheme of public works, that would secure an outlet for some $500,000,000 and give employment to an army of workers. The Freycinet Plan, as it has been termed, has, however, met with unexpected difficulty; the national finances are not in a condition to afford such outlay, and an agreement has been made with the half a dozen great railroad companies of France that they shall execute some 9,000 kilometers of the secondary net work. But this is far from being the original plan, even as to railroads, while the improvement of harbors and cuttings of canals will have to be postponed. However, the building of the narrow-gauge lines by the companies instead of by the State can hardly be regarded as a misfortune, and will eventually be profitable to the country. At the opening of the line from Calais to Auvin, a narrow-gauge line of 90 kilometers, M. Leon Say, the Minister of Finance, said: "This line penetrates into the very heart of villages, because it turns round costly property, just as an omnibus does in the streets of Paris." It cost only 70,000 francs per kilometer, while if built on the standard gauge it would have cost 250,000 francs.

It has been very well observed that railroads, and in fact all land or water routes, offer the best and most permanent of investments. Population continually increasing, not only gives them larger patronage, but demands other lines. But these other lines are only parallel to a certain extent, and thus it is, that what is often judged as a competitor, becomes *de facto* a feeder.

Railroads are not like telegraph lines—bundles of sticks and wire—they constitute solid investments, and to-day represent the greatest of all American interests, with the sole exception of agricultural. They are are destined to a growth that will be synchronous with that of the country, and the small railroad of to-day becomes the great one of ten years hence.

There is no reason, therefore, to believe that railroad building has been carried on too rapidly. Very late estimates have been made as to excessive mileage, but a careful comparison with the mileages of France, England and Germany will show the enormous margin that still exists. It is just in providing new highways of iron, and running the iron horse into undeveloped and almost boundless wastes, that American capital can be best engaged. There is even place in this line for the European capital that is now "all forlorn."

The days for Egyptian bonds are over, and English capitalists can invest better here than in combining to buy up some well patronized public house, in London, and French ones, than in subscribing to their so-called "institutions de credit."

Let us, therefore, continue to build railroads and build more than ever.

But what has done immense damage to American railroads is the speculative management of some of our railroad kings. This matter has become a national scandal, and is seriously interrupting the solid and honest development of our railroad system. The public is charged with money that has never been paid, and all the elements of a crisis are produced. The New York *Herald* in a recent article says:

"To begin at our very doors, it is well known that the six and a half million dollars of Manhattan Elevated Railroad stock represents no value whatever, and the issue by the Western Union Telegraph Company of fifteen millions, of which not a dollar was paid to the company, is fresh in the public mind. We cannot learn that any money was originally paid for any of the millions on millions of stock issued on account of the so-called Southwestern system of roads thrown on this market by a leading 'operator,' with the exception of the Missouri Pacific. From the testimony of Mr. Gould, given on the witness stand in St. Louis recently, its capital stock outstanding when he bought the road was about three-quarters of a million dollars. He paid about three millions for the controlling interest. He at once reorganized the road, and created thirty millions of stock, which was duly listed at the Stock Exchange, and he testified lately that over twenty-nine millions of it had been issued. The stock did not cost him over three millions, however, for he testified that he had received with the stock a lot of bonds and securities of other roads. The Missouri, Kansas & Texas road was an outgrowth of the Union Pacific Southern branch, to which Congress gave a land grant. We cannot learn that any money was ever paid for that stock or for that of the Iron Mountain or of the Texas Pacific. No money has been paid, so far as we can learn, on any of the branch lines of the Union Pacific, while on the thirty-six million dollars of shares on its main line issued prior to 1880 less than half a million was paid in. This list might be prolonged with Rochester & Pittsburgh, Atlantic & Pacific, East Tennessee, Virginia & Georgia, and no end of others. Millions upon millions of stocks have been listed, and this carelessness of the governors of the Stock Exchange has shaken public confidence, as well it might."

## THE SITUATION SUMMARIZED.

The summary of the progress made by the iron trade since the opening of the year shows that, notwithstanding a variety of discouraging influences, a very substantial improvement has been made. The downward tendency in prices which began last winter has been progressing quietly since that time to the present hour, and the causes at work will in all probability depress quotations until the great underlying factor in the iron problem, viz., over-production, is eliminated. The trade, recognizing this factor, has been and now is making active efforts to restrict output, and to equalize production and consumption. This is a very difficult matter, because no one individual who can make iron at a profit is willing to suspend operations to furnish wider markets or profits to another. The fact, however, is recognized that a contest at this time would be detrimental to the entire iron interest. Besides this, the new tariff law has gone into effect, and, according to cablegrams, there is considerable activity in foreign iron markets and large shipments are announced as about being made. Opinions vary as to the probable volume of importations of iron and steel. It can be asserted that there is room outside of certain finished products, such as low grade steel, steel in bars and rods, and the like. It may be possible to get rid of 50 to 100 thousand tons of Scotch, and perhaps that amount of English, but if foreign quotations represent the actual selling price as against American selling prices, this is doubtful. The British iron trade are so solicitous of finding a foreign

market in the States, that they will be apt to assume greater risks than the market warrants. Our American furnaces, and especially our steel mills, are selling their products very low, barely at cost, and are not two-thirds employed. If foreign iron and steel can be shipped and sold below the present prices, there is very little protection against it, as the cost has been reduced to about minimum limits. Much depends upon the interpretation of the new tariff legislation in some lines of goods, but in iron, the case seems pretty clear, and there is but little room for cavil.

Iron ore has been advanced to 75c. per ton; pig iron, 28c. per ton. Old rails, scrap iron, $6.72. Steel rails have been reduced $2.32 per ton. Light rails a little less. Bar iron pays from .8c. to 1.2c.; hoop iron, 1c. to 1.4c.; tin plate, 1c. per pound. These reductions have been offset in most cases by reductions in cost on this side. Labor in Bessemer mills has been reduced 32 per cent. In Merchant bar mills it is without change. Labor in furnaces has been reduced from 10 to 20 per cent., and with the blowing out of so many furnaces a further reduction will be made should the price of crude iron demand it. Hoop iron, low-grade steel and steel in various finished forms has been coming and will continue to come in considerable quantities, but as to crude iron, merchant bars, construction iron and steel rails, their importation in any considerable quantities is a matter of great doubt. In the first place, foreign bar iron is not in good repute in American markets; the tariff permits merchant steel importations. Steel rails may be imported at Gulf ports, but the volume of this business is necessarily restricted on account of trans-shipment and interior freights. Besides this, there is still room for further reduction in cost in American mills, and should importations assume larger dimensions than are anticipated, the grinding process will be resorted to for self-preservation.

Foreign markets show a declining tendency. Scotch warrants at Gla gow, July 2, were 47s. Middlesboro, Foundry, 39s.; tin, £94 10s.

As to the future of the iron trade, the most encouraging statement that can be made is that consumptive requirements must necessarily expand. There is very little disposition to contract operations, except as to the extension of producing capacity in mills and factories of various kinds. Manufacturing capacity, as a whole, has reached its climax in Northern States, but a field is opening in the Southern States for various manufacturing interests, which will be occupied by Northern capital and skill as rapidly as the transportation of capital and labor can be made. This will create a temporary lull in the older sections, but develop corresponding advantages in the new, and will go to harmonize and equalize the co-related industrial interests. The recent failures mean nothing, except to individuals. There is a wide field for energy and capital in the future, as Edison says there is in electricity, which he describes as a ten-acre lot, and our progress in it only comparable to glimpses obtained by looking through the cracks in the fence.

## CINCINNATI BOARD OF PUBLIC WORKS.

The annual Report of the Board of Public Works of Cincinnati for the year 1882, is a model city report in contents, and in the elegance of its typography and illustrations.

The report of H. J. Stanley, the Chief Engineer, is full and interesting; $273,474.81 was expended by the department in 1882. The city has awakened to the fact that it has in the past been neglecting the construction and extension of its sewerage system, and the present report contains an estimate for $1,500,000 worth of proposed sewers, and an attempt will be made to raise by a special levy the funds required for this purpose. At present but one-sixteenth of the territory of the city is sewered, or about 1¼ square miles; and only 70,000 people are afforded sewerage facilities, while 200,000 of the inhabitants are entirely unprovided for. In the matter of cesspools and vaults, the danger line has been reached. It is desirable to raise $160,000 per year for five years by a special levy, to provide for the city's portion of main sewers alone, the remainder to be assessed on abutting property.

There are now 238 miles of improved streets and alleys in the city, and $300,000 are required by the present reports for their execution. Boulder pavement and macadamized roadways predominate, each equal to 1,800,000 square yards; of Nicholson pavement there are 111,000 sq. yds., and only 14,000 sq. yds. of round block pavement; 2,676 sq. yds. of Asphaltum pavement; of limestone pavement there are now 159,547 sq. yds.

Repairs to the boulder pavements required January 1, 1883, will cost, as estimated, $224,653, at an estimated price per sq. yd. of $0.50; the estimated cost of repairs of Nicholson pavement is $83,157, at $1.50 per sq. yd.

The estimated cost of putting the streets of the entire city into good repair, is for the year 1883, $717,128, and once so repaired, it would require $320,000 to keep them in desirable condition.

The Chief Engineer recommends the tearing up of at least one half of the cobble-paved streets, crushing the cobble-stone for macadam roads, and substituting granite block pavement for the cobbles. The cost would approximate $4,000,000, and this amount must be expended before the streets of Cincinnati will compare favorably with those of the older cities. At present the property holders oppose the laying of block pavement upon some of the principal thoroughfares.

For street-lighting purposes there are now 221 4/10 miles of mains laid; the number of gas lamps burning Jan. 1, 1883, was 6,390; and the average cost for each lamp for 1882 was $27.20 6/10; the average price of gas per 1,000 ft. was $1.44. There are 1,054 gasoline lamps, costing each for 1882 $24.34-7/10.

A.T. Moore, Supt. and Eng. of the Water Department, reports 1882 as a most exceptional year of prosperity in the history of the Cincinnati Water-Works. After deducting all expense of maintenance and permanent improvements, and without a dollar of obligations unpaid, including redemption fund and interest on bonds, there still remains a surplus of $35,852.53 in the city treasury.

A permanent plant and enlarged pipe system is recommended for the "hill-top" water supply, as the present pumping service has reached its maximum. Sewage contamination makes necessary the removal of the present main Water-Works at an early date; and the financial condition of the department now warrants the undertaking the payment of interest and redemption on the $6,119,000 required to move the works to the Markley Farm, bought by the city in 1872, and to increase the hill-top supply. This estimate contemplates a supply of 100,000,000 gallons of *clear water* per 24 hours.

In connection with the Markley Farm project, Chief Engineer Stanley submits a special report for the sewerage of the eastern district of the city, at a cost of $1,680.000, together with a detailed description of the system proposed.

It is proposed to reduce the meter rate of water to nine cents per 1,000 gallons, making it lower than any other large city in the United States. To stop waste from public troughs, all such troughs are to be provided with stationary pipe and automatic stop. The recent inspections with the Bell waterphone resulted in discovering some alarming abuses of water privileges. The inspection shows that the leaks are very general, and that two-thirds of them are of the invisible order, but still leaks. There are 26,000 service branches in the city, and as under average pressure the flow of water from one water closet will be not less than 20,000 gallons per day, equivalent in cost to $2.40 per day, the importance of detecting and stopping this waste in the water supply of all large cities is of paramount importance. Of the 4,806 leaks detected in Cincinnati, 20 per cent. was due to designed abuses in water closets, 60 per cent. to carelessness in leaky taps and connections, and failure to close stops, and 20 per cent. to underground leaks.

The actual consumption of water in 1882 was 7,126,569,260 gallons, as against 8,397,654,200 gallons in 1881; in 1882 the gallons furnished per head of population was 69 7/10.

## THE DRAINAGE OF THE VALLEY OF MEXICO.

TRANSACTIONS AMERICAN SOCIETY OF CIVIL ENGINEERS.

The May number of the Transactions contains the paper upon the Drainage of the Valley of Mexico, by Francisco de Garay, C. E.; briefly referred to in ENGINEERING NEWS of May 5. The drainage of this valley of 1,800 square miles in area is a difficult subject to deal with. It is a basin receiving the water of 2,500 square miles of mountain and valley surrounding it, and prevented by natural barriers from discharging these waters into the Gulf of Mexico, through the Mocteruma River. At present the table-land of the valley is mostly occupied by different lakes, the principal and lowest of all being Lake Texcoco, with an area of 10 to 20 square leagues. As these lakes have no outlet, the waters of the most of them are saturated with the natural salts of the soil.

When the Aztecs or native Mexicans became masters of the land and founded the City of Mexico, the chief problem presented to them for solution was the prevention of the periodical inundations from the lakes. About one hundred years before the Conquest, under the reign of Montezuma Ilhuicamoira, the great dyke of Mexico was built by his nephew, the King of Texcoco, who, while famed in history as a wise legislator and a poet, should also be remembered as a daring and successful engineer.

This structure was 8 miles long, and built of rubble crowned with masonry; it ran north and south, and divided the lake into two great parts; the eastern half took the name of Lake Texcoco, and the western half was called the Lake of Mexico. By this dyke the fresh waters from the southern lakes of Chalco and Xochimilco were confined to the Lake of Mexico, and washed the shore of the city of Mexico, separated from the salt waters of the Texcoco; and the city was saved from the danger of inundation from the River Cuantitlan, the chief cause of trouble.

The Spaniards, under Cortez and his successors, not realizing the true value of the great engineering work, suffered it to fall into decay, through the agency of man and the slow work of nature. They denuded the hills of their forests, to rebuild the capital and other cities, and to deprive the natives of a refuge; the rains washed the soil into the lakes, and gradually raised their level to such a degree that they again flooded the City of Mexico. To guard against this later evil new dykes were run in all directions, and the surface of the valley soon converted into pools of stagnant waters regardless of the public health. In 1580 a general survey was made of the valley, with the view of opening a direct outlet for the water, but no actual work was accomplished. In 1605, under the pressure of new calamities, Enrico Martinez, cosmographer, mathematician and printer, came to the rescue of the threatened city, and proposed to get rid of the waters of the lakes by means of a tunnel, passing through the hills to the north of Mexico. This tunnel was more than six miles long, 10 ft. wide, and ran through a formation of hard pan, with strata of sand and marl. It was finished in the short space of eleven months, in 1608. A temporary lining of timber was at first put in it, afterward replaced by masonry. Soon after its completion it became obstructed from some unknown cause, the upper lakes were filled, and the City of Mexico once again totally flooded, and remained so for four years, during all of which time the unfortunate engineer was confined in a prison. After the floods had subsided, it was determined to replace the tunnel by an open cut, a most unwise and unfortunate decision, as events proved. The same Enrico Martinez was ordered to execute this monstrous work, and died after 35 years' labor. For 150 years this great cut of Nochistongo was the main occupation of the people of Mexico, and

was at last finished. Its greatest depth is 200 feet. millions of money were expended, and from 100,000 to 200,000 Indians perished in the undertaking.

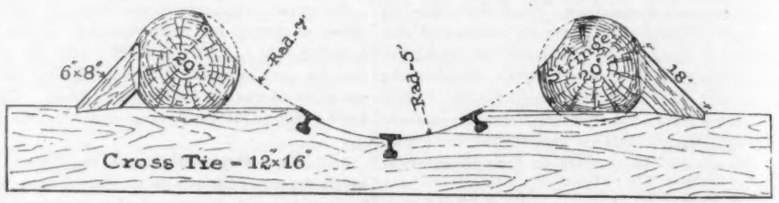
This work, begun in 1608, was never properly finished, and to this day requires constant care and labor to keep it even in tolerable service. Rapid changes are taking place in the Valley of Mexico, partly due to the direct action of nature, partly due to the agency of man; and the City of Mexico is yet periodically visited by disastrous inundations. As illustrating the changes that have taken place within the city, an Indian pavement made of cement, with a polished surface, was lately discovered 20 feet below the present ruins of the Convent of Santo Domingo, showing a constant rising of the surface by sedimentary deposit; this pavement must have been laid centuries before the Spanish Conquest, the sand employed in its construction is no longer found in the streams of the valley; a large quantity of pumice stone was also used in its composition. Cortez found Lake Texcoco an important body of water, 40 or 50 feet deep; and, to assist in capturing the City of Mexico, he constructed four brigantines on the water of this lake from material saved from his ships when he burned them in the Gulf; these same vessels were again taken to pieces, and, reconstructed, were launched on the waters of the Pacific, at Sihuatanejo, to continue the exploration of the South coast. Lake Texcoco, the place of the famous naval victory of Cortez over the native Mexicans, is now a barren, swampy plain.

Senor de Garay, many years ago, presented a complete and comprehensive plan for the drainage of this valley; his plan was approved and work commenced, but practically little was accomplished. His paper is accompanied by a map showing the details of the system proposed. Briefly outlined, this plan consists of a number of properly located collecting canals, of small section, emptying into a main canal, lying in the lowest part of the valley, about 33½ ft. wide at the bottom, 58 ft. wide at the top, and 10 ft. deep. This main canal begins at the Gate of St. Lazaro, on the eastern side of the city, and runs N. E. by E. until it reaches the center of Lake Texcoco, thence toward the north, following the general direction of the lakes Cristobal, Xaltocan and Zumpango; on reaching the slope of the hills which close the valley to the north, the canal leaves the old line of Nochistongo to the left on the western slope of the Citlaltepec Hill, and cuts through its eastern slope under the pass of Tequisquiac. At this place a tunnel about 27,566 ft. will be necessary to reach the ravine of Amatlac, that communicates with the River Tequisquiac. The total length of the main canal from the gates of the City of Mexico to the last named river will be 30¼ miles, the fall in the canal will be 1 in 8,000. The tunnel is in form a horseshoe, with an inverted arch and about 294 sq. ft. in section, with a fall of 1 in 1,000; $10,000,000 was the original estimate of cost, though the present increased price of labor in Mexico will add materially to this sum.

## OBITUARY.

MAJ. FRANCIS U. FARQUHAR, U. S. Engineer Corps, and late in charge of the river and harbor improvements of the Detroit District, died at Detroit on July 3. This announcement will be a startling one to those members of the American Society of Civil Engineers who so recently met Maj. Farquhar at St. Paul, and heard him read his able paper upon the preservation of the Falls of St. Anthony, which work was executed under his charge. The cause of death is not stated. He was born in Pennsylvania, Oct. 31, 1838, and was appointed from that State in 1857 to the Military Academy at West Point, where he was graduated in 1861. He served as Second Lieutenant in the Corps of Engineers in the rebellion, until May 5, 1862, when he was breveted First Lieutenant for gallant and meritorious services at the battle of Williamsburg, Va. He was made Captain Aug. 1, 1863, and breveted Major June 1, 1864, for his services at the battle of Cold Harbor, Va. On March 13, 1865, he was breveted Lieutenant-Colonel for "gallant and meritorious services during the rebellion." He was made Major of the Corps of Engineers July 11, 1872. Major Farquhar was acting aide-de-camp to Col. Heintzleman in the Manassas campaign, and was engaged in the battle of Bull Run. He also took part in the Virginia Peninsular campaign, and was in the siege of Yorktown. Following the battles of Williamsburg he was, as Chief Engineer of the Department of North Carolina, in the expedition which destroyed the railroad bridge over the Tar River. After the battle of Cold Harbor he participated in the siege of Petersburg. He was Assistant Professor of Engineering at West Point from Aug. 22, 1864, to June 16, 1865. He served as assistant engineer on the survey of the northern lakes from March 4, 1867, to Nov. 9, 1868, and as superintending engineer of harbor improvements on the eastern shore of Lake Michigan from Nov. 9, 1868, to June 7, 1872. He was chief astronomer of the survey of the forty-ninth parallel of latitude to fix the northern boundary of the United States from that time to Aug. 5, 1873. He was a member of the Board of Engineers in various works, including the preservation of the Falls of St. Anthony, and the improvement of low-water navigation of the Mississippi River.

He married a daughter of the late Gen. Alpheus S. Williams; his widow and three children survive him.




LOGGING ON THE COLUMBIA RIVER.
(Omitted from article, page 294, *ante*.)

## PERSONAL.

ISAAC S. CASSIN, Civil and Mechanical Engineer of Philadelphia, is constructing water-works at Birdsboro, Pa., and enlarging the water-works at Doylestown, Pa.

HOWARD MURPHY, C. E., Secretary and Treasurer of the Engineers' Club, of Philadelphia, has been appointed Hydraulic Engineer to devise a system of water supply to the new public buildings in Philadelphia, and to superintend the construction of the same.

M. WALDORP, one of the most distinguished engineers of Holland, was lately in Rio Janeiro, where he was most cordially received by the Engineering Club of that city. M. WALDORP is a Councilor of State, was one of the International Commission for improving the Danube, and was also engaged in building the new port of Batavia.

# CORRESPONDENCE.

## RAILROADING IN MEXICO.

AGUASCALIENTES, Mexico, May 21, 1883.

EDITOR ENGINEERING NEWS:

We are getting along rapidly with the grading at both ends of the road—Mexican Central—and the indications are that the main line will be completed by May 1, 1884. The end of track at south end has been for nearly two months at Encarnacion, 540 kilometers north of City of Mexico. The line here crosses the Encarnacion River at an elevation of about 130 ft. above the stream. A large iron bridge (the largest on the road) has been built in England for this crossing, but it has not yet arrived, and consequently the track is stopped until a temporary wooden bridge, on which they are working at present, can be completed. The grading forces (all native Indians) are extended ahead over 180 kilometers. A competent engineer is in charge of each 15 kilometers, which constitute a "residency." He has an assistant (generally an American), who is competent to run instruments, etc. All the rest of his assistants are natives, who are paid generally 50 cents a day and board themselves. Three or more of these residencies constitute a division, in charge of a division engineer.

At the south end R. E. Briggs is chief engineer; Geo. C. Cleveland, principal assistant. C. L. De Ham, Arthur Pou and Thos. J. Rask are division engineers. F. L. Richardson, R. L. Davies, G. A. Miller, C. R. Hunt, A. Lorenz, M. Buhle, F. C. Balch, I. W. Van Leer, J. S. Elliott, E. Greig, T. J. Sweeny, G. E. Pillsbury and G. E. Fuller are resident engineers. J. K. Heaton is in charge of several parties locating the line from Fresnillo north, and the entire location of the main line will be completed within a few months.

Nearly all the engineers are Americans, and they are plentiful at salaries generally about 25 per cent. more than they would get in the same position in the United States. When other roads commence constructing in earnest prices will probably be better.

## METHODS OF DESIGNING HIGHWAY BRIDGES.

TOKIO, Japan, June 9, 1883.

EDITOR ENGINEERING NEWS:

In your issue of May 5 there appeared a short and rather unfavorable criticism of a paper of mine, which was read before the American Society of Civil Engineers on May 2. As I consider that the paper has been too summarily dealt with, will you kindly allow me a few lines of ENGINEERING NEWS for explanation?

In the first place the title of the paper was incorrectly given. As I wrote, it was "General Specifications for Ordinary Iron Highway Bridges," and not "Methods of Designing Highway Bridges," nor, as announced for reading by the Secretary, "Suggestions as to the Conditions proper to be Required in Highway Bridge Construction."

It is evident that there is a radical difference in these titles, for the paper treats of *iron* bridges only. In regard to the objection raised at the meeting, that the paper is too voluminous for engineers and not full enough for the non-professional, I would state that, first, if the paper is lengthy, it is systematically arranged and divided, each division being recorded at the side, as is customary in specifications, so that an engineer in designing a bridge by the data can turn immediately to what he wants. In designing too much cannot be known; consequently in giving instructions for designing too much cannot be told, provided that it be told in such a manner as not to confuse the reader, which, I contend, has been done in my paper.

Secondly, as to non-professional readers, it must be acknowledged that no amount of explanation will enable an ordinary county commissioner to either design a bridge or pass a perfectly reliable opinion on one that is already built, still a great many points may be shown him, by means of which he can prove that a certain bridge is *not* up to standard specifications. Such points you will find in my paper—for instance, "Limiting lengths of spans for different clear roadways and for pony trusses," limiting depth of pony trusses with and without side bracing, "limiting length of span for double intersection bridges," "minimum allowable sections for rods and channels, least allowable thickness of iron, "sizes for upper lateral rods," necessity for upset rods, "minimum dimensions for chord and batter brace plates," the correct

sizes of lattice bars, lacing bars and stay plates for *every case*, the correct inclinations of lattice and lacing bars, least allowable thickness of beam hanger, roller and shoe plates, etc., etc.

There is one case in which my paper would be especially useful, *i. e.*, where an engineer, who has not made a special study of bridge work, is called upon to act as consulting engineer at a bridge letting.

In regard to Mr. Cooper's remarks, I agree with him that it is necessary to have an intelligent engineer to see that the work specified and paid for is obtained. In fact, in one or two articles that have lately appeared in American engineering papers I have mentioned this fact, though in a slightly different manner.

As to his remark concerning "patchwork specifications," I would state that a great deal of the matter in my paper is original, but that necessarily some had to be taken from standard specifications. In doing so I tried to avoid anything that would cause confliction, but if I have been unsuccessful in this endeavor, I would be greatly obliged to Mr. Cooper if he would kindly write me and point out the objectionable features, for, if my paper does not appear in the Trans. of the Am. Soc. Civ. Engs. it will appear elsewhere shortly, and perhaps later on in book form with my other papers upon bridges, after I will have finished the series upon which I am engaged. The book, if published, is to contain all necessary information for designing *ordinary* highway and railroad bridges, together with a large number of tables for facilitating the calculations and reducing the labor of ordinary bridge designing to a minimum. On this account suggestions from Mr. Cooper or any other engineer will be very thankfully received.

All typographical and other errors that may exist in the various papers will be corrected in the book, and additions or changes will be made wherever it may appear advisable. Since writing the "general specifications" I have thought of several clauses which I would like to add; one upon the limiting slope for batter braces of pony trusses, another upon continuous spans, and another upon hip verticals. Then, too, I would like to change the clause concerning the limiting length of span for double intersection bridges, so as to make it agree with the results of later investigations made in connection with my paper on "Economy in Highway Bridges," which is soon to appear in the Proceedings of the Engineers' Club of Philadelphia. Very respectfully yours,

J. A. L. WADDELL.

## THE HISTORY AND STATISTICS OF AMERICAN WATER-WORKS.

BY J. JAMES R. CROES, M. AM. SOC. C. E.

(*Continued from page* 279.)

DXLI.—OGDEN CITY, UTAH.

Ogden City, Utah, in lat. 41° 15′ N., long. 112° 10′ W., on Weber and Ogden rivers, is in Salt Lake Valley, at the foot of the Wahsatch range of mountains, and is 4,200 feet above the sea.

It was settled in 1850, and incorporated in 1851. Water-works were built in 1881 by Joseph A. West and David Jenkins for a private company.

The supply is taken from the Ogden River, which rises in the Wahsatch Mountains. A dam five feet high across the stream forms a reservoir holding 300,000 gallons at 250 feet above the lowest part of the city, and about 100 feet above the highest part. The water is conveyed to the city by three miles of 8-inch wooden pipe, known as "Horton's." Distribution is by eleven miles of wooden pipe of from 8 to 2½ in. in diameter, with 34 fire hydrants, 50 gates and 250 taps. The city pays $1,650 per year for hydrants. Service pipes are of galvanized iron.

The population in 1880 was 6,069. The daily consumption in 1882 was about 300,000 gallons. The capital stock of the company is $150,000. The works cost $65,600. There is no debt. The receipts for the five months of 1882, during which the works were in operation, were $4,000.

E. H. Orth is President and James Taylor Secretary of the company.

DXLII.—SAN JOSE, CAL.

San Jose, California, in lat. 37° 20′ N., long. 121° 50′ W., is on Los Gatos Creek, which receives the drainage of 17 square miles of mountainous country.

Settled in 1848, it was incorporated in 1851. Water-works were built in 1864 by M. Chabot for a private company. The supply is taken from two impounding reservoirs of 22 and 12 acres, which receive the drainage of ½ square miles and from the stream. The water is conveyed through 12 miles of wooden flumes and concrete conduits to a reservoir holding 2,000,000 gallons, 70 feet above the city. In dry seasons, an additional supply of about 40,000 gallons per hour is obtained by pumping from seven artesian wells by a No. 10 Knowles pump.

Distribution is by 59 miles of cast iron and sheet iron pipes of from 22 to 3 inches diameter, with 50 fire hydrants and 2,500 taps. There are 13 meters in use. The city pays nothing for hydrants and for water for flushing sewers, but pays 15 cents per thousand gallons for water for sprinkling streets.

The population in 1880 was 12,567 in San Jose and 2,416 in Santa Clara, which is supplied from the same works.

The daily consumption is 800,000 gallons in winter and 3,000,000 gallons in summer. The works have cost $400,000. There is no debt. The expenses in 1882 were $25,000 and the receipts $60,000. Ed. Williams is President, D. W. S. Eyster, Secretary, and W. J. Willcox, Superintendent.

## NEWS OF THE WEEK.

THE NEW JERSEY RAILWAY BRIDGES.—There is much discussion with regard to the condition of the bridges on the Long Branch road. t seemed that a contract had been entered into between the Central Railroad of New Jersey and the Pennsylvania Railroad Company, which provided for the joint use by those companies of the New York & Long Branch Railroad between Perth Amboy and Bay Head City, and it was agreed that that line should be put in first class condition.

The repairs and improvements necessary to accomplish this were to be made by the New York & Long Branch Railroad Company, which company is controlled absolutely by the Central Railroad Company of New Jersey.

This latter company had two of the most experienced bridge engineers in the country, Mr. J. H. Linville, formerly of the Keystone Bridge Works, and Mr. Alfred P. Boller, of New York, to inspect the bridges on that line and report thereon. On the 1st of June, 1883, they reported that the bridges, trestleworks and draws on the said road were not adequate to its safe operation with the engines used by the Central Railroad of New Jersey and the Pennsylvania Railroad, and that the excessive strains upon the timbers composing these structures would probably produce disastrous results. They examined each bridge and trestle in detail and the whole burden of their report is that many of the piles had been eaten by the teredo, and that others were small and rotten, and that generally all these structures were strained from eighty to one hundred per cent. beyond what was safe and justified by existing practice.

In consequence of this report, the speed on the New York & Long Branch road was reduced to 15 miles an hour. The officers of the Central have been averse to carrying out this order, and have thus come into conflict with the Pennsylvania Railroad, which has applied to the U. S. Court at Trenton to appoint a superintendent.

The affidavits submitted in support of this application, made by Mr Roberts, President of the Pennsylvania Railroad Company; Mr. Frank Thomson, second vice-president; Mr. Charles E. Pugh, general manager; Mr. Joseph M. Wilson, bridge expert; Mr. Hiram T. Brooks, Superintendent of bridges on the Philadelphia & Erie Railroad; state that the bridges are insecure.

MACHINERY FOR WATER-WORKS.—Charles T. Porter, mechanical expert, who has an office in the Tribune Building, New York City, and who recently made a test of the new Holly machinery (Gaskill engines) at the water-works pumping station here, under the direction of the Board of Water Commissioners, has submitted his preliminary report. At a special meeting of the Board yesterday evening the report was formally opened and read. It reported in favor of the new machinery, which, he said, exceeded the guarantee 28 per cent. Mr. Porter will make his complete report in about two weeks. This machinery has been twice officially tested, the first time being by J. W. Hill, a Cincinnati, Ohio, expert. The report of both substantially agree. The Gaskill is a machine of entirely new design, and the one here is said to have been the first one of the kind made.—*Saratoga Springs Correspondence N. Y. Tribune, July* 1.

THE CONTRACT FOR THE CONSTRUCTION of the Columbus & Cincinnati Midland Railway has been let.

THE FLOODS AND THE RAILROADS.—The roads suffered severely in the flooded districts—all those leading into St. Louis, except the Vandalia, suffered severely.

RAILROADS IN NEW JERSEY.—The Commissioner of Railroad Taxation places the value of the railroads in the State at $200,000,000, an increase of $3,000,000 since last report.

PORT HURON (MICH.) REQUIRES SEWERS.—Several plans have been proposed. Some are in favor of emptying into Black River and others St. Clair River.

AT A MEETING OF THE PHILADELPHIA Councils Committee on Surveys, on Monday, a communication was read from the Chief Engineer of the Water Department, which had been received by Chief Surveyor Smedley. The letter points out many objectionable features in the drawings for the intercepting sewer, from Manayunk to Fairmount.

A TRESTLE WORK, 70 feet high, on the Canadian Pacific, British Columbia, fell down some days ago with three bridge builders, of whom two were fatally injured.

THE WATERPHONE IN JERSEY CITY.—The Chief Engineer of Jersey City presented the following in relation to the waterphone tests, which was received and referred to the Committee of the Whole: JERSEY CITY, June 23, 1883.

*Hon. Board of Public Works:*

Gentlemen: I have to report to your Hon. body, that during the past three weeks the night inspections with the Bell Waterphone have been steadily progressing. During this time, out of 993 inspections made there were discovered 553 buildings in which the water was running to waste, or about 56 per centum of the entire number of houses inspected during the three weeks. In many of these houses three or four separate leaks were discovered. The annexed schedule will show the night inspections in detail, together with the nature of the leaks discovered. I have no doubt that should your Board see fit to adopt this system and strictly enforce the rules on the subject of defective water fixtures, a saving of at least 35 per centum of the whole amount of water pumped could be effected. As every gallon of water supplied to our citizens has to be pumped at a fixed cost for fuel, etc., the saving to be made by the adoption of the waterphone would be considerable. Owing to the large amount of water wanted in this city, our conduits and engines are taxed to their utmost capacity, and unless something is soon done to check this waste we will be obliged to lay an additional conduit from Belleville to supply our needs. The adoption of this system will not entail the use of waste by our citizen in any way. It will merely stop the waste of water occasioned by leaky and defective fixtures, from which the water now runs into sewers without being of any service to any one. I would strongly recommend to your Board to effect some arrangement by which we can introduce this system of waste detection into our city with as little delay as possible."

RAILWAY PROGRESS.—The Milford, Franklin and Providence Railroad, now nearly completed, will be opened about the middle of the present month.

THE EXTENSION OF THE MARQUETTE, HOUGHTON AND ONTONAGON Railway is being rapidly pushed, over ten miles of track having already been laid. The entire right of way is cut out, and work on the middle and Houghton end of the road is progressing with a rapidity which insures its completion within the time required by contract.

NEW ROADS—THE MERIDEN (CON.) AND CROMWELL.—The Railroad Commissioners will approve the proposed layout of the Meriden and Cromwell road, and the work will begin in a few days.

THE ST. CROIX RAILROAD.—This line has been incorporated. It is to take the construction of a railway from some point to a junction with the Chicago, St. Paul, Minneapolis & Omaha road at or near the station of Woodville, in St. Croix County, through the county of St. Croix to a point of connection with the Chippewa Falls & Northern Railway at the station of Cameron, with a branch from some point within the county of St. Croix to be fixed by the board of directors to a point on the St. Croix River, at or near St. Croix Falls, in Polk County. The length of the road will be about 90 miles, and it will extend through portions of the counties of St. Croix, Polk, Dunn and Barron. The capital stock is $750,000.

STOPPING A SURVEY.—SEATTLE (W. T.), June 28.—The Indians of the lower Sound, along the Skagit River, have for some years prevented a government survey of the valuable timber lands above the confluence of the Sauk River with the Skagit River and the neighborhood of the Skagit mines. Recently the Surveyor-General let a contract for surveying three townships there, but on reaching the scene of operations the party was met by the Indians who, declared that they would kill the whites should they endeavor to do the work. The Indians of the reservation are joining the Skagit tribe, so that there are about 200, who will resist the surveying party. The surveyor who has the contract to do the work came to Seattle to get as-

sistance to protect himself and his men while in the mountains.

HIGH water in the Colorado River has delayed the construction of the bridge which is to connect the Central Pacific with the Atlantic & Pacific.

A NEW LINE FROM ST. LOUIS TO SAN FRANCISCO, with branches to Texas and the Indian Territory, is spoken of. It will be a parallel line.

PORT HURON (Mich.) will spend $25,000 on sewers.

THE PORT HURON COUNCIL has ordered plans and specifications for a new iron bridge to span Black River at the function of Military street and Huron avenue.

THE GREATEST WATERFALL.—A recent discovery on the head of the Cowlitz River establishes the fact that Washington Territory can now boast of the grandest waterfall in the known word, its height being 1,500 feet. The Nook-ack Indians assert positively that waterfalls higher than the tallest fir, pine, or cedar tree are to be found on the extreme head-waters of the Nooksack River in this county. As that section of the county has never yet been explored by the white man, there is no good reason for doubting the statement. From the comparison given by the Indians these falls must be at least 475 feet in height, which would lay over the famous Snoqualmie Falls, of King County, by at least 200 feet.

THE AQUEDUCT COMMISSION.—The new Croton Aqueduct Commissioners met in the Mayor's office on Thursday, and elected Mayor Edson President. Commissioner Lane was absent in Europe, and Commissioner Thompson was absent because of sickness. Deputy Public Works Commissioner Hamlin acted as secretary. Commissioner Spencer reported a series of rules and regulations for the government of the commission, which were adopted after a very long debate. The rules provide for a President, Vice-President, Secretary, Auditor, and such engineers, clerks, employes, etc., as the commission sees fit to appoint. The terms of office of all employes are to be at the will of the commission. Stated meetings of the commission are to be held every Wednesday, beginning on August 1. After the rules had been adopted, Commissioner Dowd was elected Vice-President, and Commissioner Spencer moved that Deputy uPblic Works Commissioner Hamlin be elected permanent secretary. Mayor Edson remarked that there were a number of applicants for that position, and at his suggestion the matter was not decided. Commissioner Spencer introduced a resolution calling on the Commissioner of Public Works to submit to the commission as soon as possible plans, maps, specifications, estimates and particulars for the construction of the proposed new aqueduct. The resolution was adopted. Commissioners Spencer, Dowd and Thompson were appointed a committee to find quarters for the commission, and the committee immediately decided upon rooms in the *Tribune* building. Various standing committees were appointed, and then the commission adjourned.

THE ARGENTINE CENTRAL RAILROAD will be extended to Bolivia.

THE CAPE COD SHIP CANAL.—BOSTON, July 5.—The new Cape Cod Ship Canal Company met for organization to-day, and accepted the charter voted last week by the Legislature. By-laws were adopted, and the following Board of Directors were chosen: William Seward, Jr., of New York; Joseph T. Hoile, of Boston; Samuel Fessenden, of Sandwich; George S. Hall, of Boston; Edwin Reed, of Boston; William A. Clark, Jr., of Boston; and John Styles, of New York. By the terms of the charter the company must deposit $200,000, and do a certain amount of actual work within four months. The capital named in the act of incorporation is from $2,000,000 to $5,000,000. The corporators affirm that they have ample funds behind them to build the canal, whatever the cost. The New York interest is very large. The proposed location of the canal is substantially the same as that on which the old company began work. The immediate requirements of the charter will at once be complied with. The organization of the company will be perfected to-morrow.

FINISHING THE EAST RIVER BRIDGE.—The traction rope which will be used in hauling the cars backward and forward on the northerly track was placed in position on Tuesday. Its companion will be extended across the southern track as soon as it is completed. It is extremely doubtful if the cars themselves are in running order for the public before the latter part of this month or the early part of the month following. It is agreed among the trustees that the railroad shall not be brought into operation until everything about it is perfected. In other words, it will not be thrown open to the public until it is in perfect readiness throughout.

Proposals for the building of an iron viaduct across Sands street, at the Brooklyn approach, and for the conversion of the arches in the New York approaches into warehouses have been called for by the trustees. A number have already been submitted, but the names of the contractors and the amounts for which they agree to do the work cannot be ascertained until Monday next, when the bids will be opened by the trustees. Yesterday had been fixed for this purpose, but in the absence of a quorum the duty was postponed. The viaduct is for the purpose of conecting the bridge railroad station with a storage platform for cars, to be situated between Sands and High streets. The last Legislature authorized the acquirement of a strip of land 100 feet in width along Washington street, between Sands and High streets, for bridge purposes, and, acting under this authority, the trustees purchased the private property thus described, and for some weeks the process of leveling to the ground the buildings upon it has been in progress. At certain hours of the day it is probable that the number of persons who will make use of the railroad across the bridge will be very large. To accommodate them extra cars and additional trains will be necessary. The storage platform will be built for the purpose of containing the cars that will be required on these occasions, and that will naturally be taken off during those parts of the day when travel is comparatively light.

The specifications for fitting up the archways call for work that, when completed, will give a superior class of warehouses in the arches of the New York approach. In the rear of the New York anchorage two arches are to be prepared, each three stories in height. Between Pearl and Cliff streets there are four arches of three stories in height to be fitted up; between Cliff and Vandewater streets, five arches of three stories; between Vandewater and Rose streets, six arches, of two stories, and between Rose and William streets, three arches of two stories. The contracts call for the use of 1,250,000 pounds of steel girders, and 825,000 pounds of iron beams and connections. The floors are to be of Georgia pine, and the masonry, fire-proof beams, plastering, stairs, ventilators, and means of lighting are all to be first class. Iron doors are to be supplied at the openings on the cross streets, and in addition to being well lighted and ventilated the warehouses are to be supplied with gas and water pipes, and the plumbing generally must be in rigid accordance with the sanitary requirements of the Health Department. The trustees believe that these warehouses will lease readily, and that the income from them will be a revenue of great importance to the bridge.

TOWN ELECTRICIAN.—This will no doubt be a new occupation of a semi-political character. D. Palmer has been appointed town electrician of Englewood, Ill.

THE BROOKS LOCOMOTIVE WORKS, at Dunkirk, N. Y., shut down on June 30. The cause assigned is the decrease in orders owing to dullness in railroad building.

THE NEW LONDON BRIDGE.—The map of the proposed bridge at New London shows that it is to be of iron, supported by seven granite piers, a large round pier to be in the center of the river at Winthrop's Point, on which the draw will be worked. The draw will move on a pivot, and, when open, will leave a clear space of water on each side of the pier of over 250 feet. The draw-bridge will be 24 feet and 6 inches above mean low water.

OF THE PEOPLE'S RAILWAY the Indianapolis *Journal* says: "The press of the country is doing good service in exposing and denouncing the People's Railway scheme. The probabilities are that the 'plan' will be thoroughly and promptly squelched, despite the names of a few reputable men attached to it, and who, so far, have not seen fit to withdraw their influence from the ridiculous affair. With men of a keen and fine sense of moral responsibility to the public, no time would have been lost in making it known that they had nothing to do with such a bald humbug."

THE TELEPHONE BUSINESS would seem to be overdone. All the New England exchanges, including those owned by Lowell and the Boston Exchange, will be consolidated into one company under the title of the New England Telephone Company.

THE FELTON & PESCADERO RAILWAY COMPANY has been incorporated in San Mateo County, Cal. The capital stock is $500,000. The length is 50 miles.

SURVEY IN CANADA.—A survey is to be made by the government of the country lying between Lake St. John and Hudson Bay.

THE ENGINEERS OF THE LAKE ERIE, WOOSTER & MUSKINGUM Railroad are now surveying the line to Millersburg, O.

SURVEYORS ARE AT WORK AT KENT, OHIO, on an extension of the old Clinton Air Line.

THE JOLIET WATER-WORKS were recently sold by order of Court to Joseph Hiller Foster, of Portsmouth, N. H., for $54,000 cash.

SURVEY OF TEXAS.—The United States department has ordered an expedition to complete the survey of the country west of the Rio Pecos. The expedition will be under Chief Engineer Livermore. It is believed there will be encounters with Indians.

A SURVEY OF A NEW LINE.—The Metropolis, Wetanga & Chicago Railroad has been surveyed by Capt. William Johnson and a corps of engineers. The survey gives a very easy route. The line is about 23 miles im length.

THE CITY ENGINEER OF AKRON, O., Mr. O. N. Gardner, recently sent in his resignation to the Council, but the members seemed unwilling to accept it. Mr. Gardner has been offered a more lucrative position.

NEW ROADS.—*The Fort Wayne and Indianapolis* Co. have filed articles of incorporation at Indianapolis. The proposed line is to extend from Fort Wayne to Indianapolis through the counties of Allen, Wells, Huntington, Grant, Tipton, Madison, Hamilton and Marion, a distance of 106 miles. The capital is $50,000. *The Fort Wayne, Peoria and Galesburg* Railroad has also been incorporated by the same stockholders for building a road from the Indiana and Illinois State line to Fort Wayne. The length will be 147 miles and the capital $50,000.

HAVERHILL (MASS.) has appropriated $50,000 for a new draw, but the people require a new bridge built.

LOWELL IS TO HAVE A NEW BRIDGE over the Concord to cost $75,000.

EXTENSION OF THE NORWICH AND WORCESTER.—The directors voted at Worcester on Thursday last to extend the road from Allyn's Point to Groton, Ct., at a cost of $356,000.

IN the *North American Review* for July, President Julius H. Seelye writes of "Dynamite as a Factor in Civilizaton," taking of the subject the reassuring view that dynamitism being merely a symptom of present discontent, is necessarily a transient social phenomenon, which will quickly disappear as the institutions of government are brought more into harmony with the interests of and aspirations of the masses of the people. In "The Last Days of the Rebellion," Lieutenant-General P. H. Sheridan recounts the operations of the cavalry divisions under his command during the week preceding the surrender of Lee, and offers a highly important contribution to the history of the late war. William S. Holman, M. C., makes a striking exhibit of "The Increase of Public Expenditures," and insists upon the necessity for unceasing vigilance on the part of the people, lest the burdens of governmental administration become intolerable. "Democracy and Moral Progress," by O. B. Frothingham, is a philosophic forecast of the probable outcome of "government by the people themselves." Z. R. Brockway, Superintendent of the Reformatory at Elmira, N. Y., points out some "Needed Reforms in Prison Management;" Thoams Sergeant Perry writes of "Science and the Imagination;" George E. Waring, Jr., of "Sanitary Drainage;" Elbridge T. Gerry of "Cruelty to Children," and finally there is a Symposium on "Church Attendance"—the question whether the churches are growing to be less of a power for good now than in former times—the symposiasts being "A Non-Church Goer," Rev. Dr. Wm. Haynes Ward, Rev. Dr. James M. Pullman and Rev. Dr. J. H. Rylance. Published at 30 Lafayette Place, New York.

FAST TIME ON UNION PACIFIC.—The time between Omaha and San Francisco has been reduced to 3½ days.

JACKSONVILLE AND TAMPA R. R. CO.—Incorporated for the purpose of constructing a railroad from the City of Jacksonville, Fla., through Clay, Putnam, Marion, Sumter and Hernando Counties to the City of Tampa, in Hillsborough County. The length to be about 200 miles. The capital stock $2,000,000. The directors are R. H. Mason, G. P. Healy and L. N. Wilkie, all of Palatka, Fla.

ST. JOHN'S RIVER R. R. CO.—Incorporated for the purpose of constructing a railroad from the city of Jacksonville, in Duval County, through the counties of Duval, St. John's, Putnam and Volusia, to Enterprise, in the county of Volusia. The length to be about 140 miles. The capital stock of said company shall be $1,000,000. The names of the directors for the first year, are R. McLaughlin, D. Eagan, C. C. Collins, of Jacksonville, Fla., and S. B. Carter, of Chicago, Ill.

REMOVAL OF WRECK OF NANKIN.—Bids for the removal of the sunken wreck of the steamer Nankin were formally opened at the office of G. L. Gillespie, Major of Engineers and Brevet Colonel of the United States Army, Army building, this city, at 12 o'clock 30th ult.

This formidable obstruction to the navigation of New York harbor was caused by the sinking of the iron steamer Nankin, through a collision on April 28, 1882, when bound out for Liverpool ballasted with coal, stone and earth. The iron hull registered 2,423 tons and was 330 feet long, with two iron decks and beams and four iron bulkheads. The Nankin now lies sunk in the Swash Channel of the Lower bay, five-eighths of a mile west by

north from the stone beacon on Romer shoal and three and seven-eighths miles north-northwest from Sandy Hook main light, in from twenty-five to twenty-six feet of water at low tide. The wreck is broken in two about sixty-five feet abaft the middle of its length, and by previous attempts made at its removal some 300 tons of iron have been taken away. The United States Government, in its advertisement for proposals to remove this obstruction, have stipulated among other things that the operating contractor may use any means he pleases to clear the channel, provided that such means do not unnecessarily destroy those portions of the wreck that would be valuable when raised; that the operations must be conducted upon the supervision of an inspector appointed by the United States engineer officer in charge; and that the work must be completed by June 30, 1884, and sooner, if possible. Bids for the removal of the wreck and the purchase of its material were received conjointly and were as follows: Samuel R. Cummings $29,974, allowing for its material $6,000, leaving the cost to the government $23,974; E. R. Low, $53,961, allowing $7.50 per ton of material raised. George W. Townsend bid $38,000 for the work, allowing $19,000 for the material, with a cost to the government of $19,000. I. J. Merritt bid $40,000, allowing $15,000 for material, making the cost of removal $25,000. Edward McDonald bid $27,000, allowing $5,000 for material, leaving the removal cost $22,000. As can be seen, George W. Townsend is the lowest bidder, in fact, but his offer was accompanied with a stipulation for more time, as he wanted eighteen months to perform the work. I. J. Merritt's proposal is the lowest one in point of law. All proposals go immediately to Washington, where the decision will be made and the contract awarded in a few days, it is expected. Though an obstruction to the channel, this wreck has not lessened the depth of the water, as has been recklessly stated.

THE HARRISBURG & WESTERN R. R.—The route which is to be adopted by the directors of the Harrisburg & Western, Vanderbilt's projected rival for the Pennsylvania, has finally been announced. The Pittsburgh *Dispatch* gives these details: The road leaves Harrisburg, where it connects with the Philadelphia & Reading going east, and runs in a direct line 100 miles to Bedford, then to Somerset, to near Mt. Pleasant and down the Big Sewickley valley to its mouth, where it intersects the Pittsburgh, McKeesport & Youghiogheny, twenty-nine miles from Pittsburgh, thus forming a line from Harrisburg to Pittsburgh 229 miles in length. The road will cross the Chartiers & Youghiogheny by an overhead bridge in the Big Sewickley valley. Two overhead bridge crossings of the Southwest Pennsylvania will be made, one near Mt. Pleasant and the other near Paintersville, Westmoreland County. The only bridge of extraordinary magnitude will be the one at Harrisburg, crossing the Susquehanna. The bridge has not been contracted for as published, and instead of costing $2,000,000, it will cost but $500,000. It will be an iron truss of the latest improved pattern, and the contract for its construction will be let in the fall. Ten great tunnels will be constructed, some of them unusually large. The first is the Blue Ridge, twenty-five miles west of Harrisburg, 4,350 ft.; second, one mile west of the Blue Ridge, the Kittatinny tunnel, 4,635 ft.; third, Tuscarora tunnel. 5,290 ft.; fourth, Sidling Hill tunnel, 6,300 ft.; fifth, Ray's Hill tunnel, 3,700 ft.; sixth, Allegheny Mountain tunnel, 5,900 ft.; seventh, Negro Mountain tunnel, 1,800 ft; eighth, Quemahoning tunnel, 2,000 ft.; ninth, Laurel Hill tunnel, 5,300 ft.; tenth, Sewickley tunnel, 1,900 ft. The right of way for nearly the whole line has been obtained and generally by free releases from the land owners. No serious difficulty has been encountered in this respect. The company has secured a tract of land on the west side of the Susquehanna, opposite Harrisburg, known as the Walton farm, containing 245 acres, for terminal facilities. At other points along the line ample grounds for station purposes have been secured. When shops will be required they will be erected at Harrisburg. The road is to be built in the best manner with double track, 70-pound steel rails and every known improvement. The contracts will be let by September 1, and work begun at once. The first labor will begin at the heaviest work, on the tunnels. It is proposed to prosecute construction with energy, and it will take two years at the shortest to complete the line. It is estimated that it will cost $20,000,000 for a two-track road from Harrisburg to the junction with the Pittsburgh, McKeesport & Youghiogheny, or $100,000 per mile. The Pittsburgh, McKeesport & Youghiogheny furnish the terminal facilities at Pittsburgh. The Monongahela River is recrossed within the city limits and then over another line, the passenger depots are reached. This new bridge will be the junction railroad bridge at Four Mile Run, for which Jones & McLaughlins hold the charter. This proves conclusively that over the Pittsburgh East End Vanderbilt's trunk line will enter Pittsburgh.

SHIPPING FROM SAN FRANCISCO TO NEW ORLEANS.—A Galveston dispatch says: "Preparations are maturing on the Sunset & New Orleans branch of the Southern Pacific for immense shipments of California wheat through to New Orleans. The initial car-load is to be followed by express grain-trains to be started in a short time.

THE MILWAUKEE & BISMARCK RAILROAD.—People are no longer in suspense as to the course over which the Milwaukee company will run their line. Several of Huron's workers met Manager Merrill with carriages at Letcher to convey him to that city, but Mr. Merrill did not allow himself to become under obligations, but hired a team and, taking his surveyor, drove to Huron, looked over the situation and ordered his surveyor back to Letcher to continue work on the survey.

THE MANITOBA RAILROAD opened its branch from Shirley to St. Hilaire, a distance of 22 miles, on July 1.

THE DULUTH AND IRON RANGE.—Six hundred men are now at work on this road, grading, and over one hundred on the docks at Two Harbors. The number of hands will soon be increased.

THE CONTRACT FOR THE NEW CRUISERS.—John Roach & Son, of Chester, Pa., came off victorious in the contest for the new steel cruisers, having been the lowest bidders for the three men-of-war and the dispatch boat. The bidders on each craft were as follows: The Chicago—Delamater & Co., New York, $1,163,000; Harlan & Hollingsworth Company, Wilmington, Del., $1,120,000; Cramp & Sons, Philadelphia, $1,080,000, and John Roach & Son, Chester, $889,000. The Boston—Harlan & Hollingsworth Company, $777,000; Cramp & Sons, $650,000; Harrison Loring, Boston, Mass., $748,000, and John Roach, $619,000. The Atlanta—Harlan & Hollingsworth Company, $775,000; Quintard Iron Works, New York, $763,400; Cramp & Sons, $650,000, and John Roach & Son, $617.000. The dispatch boat Dolphin—H. A. Ramsay & Co., Baltimore, Md., $420,000; Allen & Blaisdell, St. Louis, Mo., $380,000; Cramp & Sons, $375,000, and John Roach $315,000. Mr. Roach's total was $2,440,000, against $2,755,000 of Cramp & Sons, the next lowest bidder. The contracts will probably be awarded on Wednesday, or as soon as the proper bonds are filed with the Secretary of the Navy. The unsuccessful bidders are a unit on the statement that the ships cannot be built for the money. Charles Cramp says it is ridiculous to talk of building the Chicago for $889,000 when the estimate of the Advisory Board was $1,248,000. As will be seen, the Cramp bid was the next lowest, at $1,080,000. Both of these firms have extensive plants, while the others have very little, the St. Louis firm, Allen & Blaisdell, competing for the first time for such construction. The latter firm, however, only bid on the dispatch boat, that being the only one which could be got to sea from their yard, their bid on the dispatch boat ($390,000) being $65,000 above that of the Roaches. The Gorringe Company, Puzy & Jones, and several other shipbuilders contemplated competing for the prize, but when Secretary Chandler announced, some days ago, the amount that would be allowed for the construction of these vessels, they concluded that there was no money in them at that price.

CANADIAN RAILROADS will be greatly benefited by the development of the phosphate industries. The Ottawa Colonization Railway will soon be begun. It starts from near Rockland to connect with the Ottawa & Gatineau Valley road at Aylurin, which latter road is also to be rapidly pushed forward.

BELLEFONTAINE WATER-WORKS.—There was a large number of bidders for parts or the whole of the work. The contract was let entire for $53,580.

IRON BRIDGE.—The Commissioners of Chatham, N. Y., have authorized a bridge to be built across the Sternekill River.

BOSTON WATER-WORKS.—The Boston Machine Co. have been awarded the contract for furnishing water gates. Price $4,695.

MEXICAN RAILROAD NOTES.—The following notes are from the *Mexican Financier* of recent date:

By July 15 next it is expected to open the line of the National Railroad from Monterey to Saltillo. The telegraph line belonging to the same company has been opened to Saltillo.

Congress has approved of the contract given to General Cravioto, Huachinango, for constructing a railroad from Apisaco to Huachinango.

An official inspection of the railway from Puebla to Izucar de Matamoros shows the rails to have been laid to kilometre 37 (24 miles). The telegraph line has been completed to Izucar de Matamoros. During April a total of 11,402 passengers was carried over the road.

The inauguration of work on the Eads tramway at Coatzacoalcos was witnessed by General Enrique Mexia, M. Van Brocklin, Carlos J. Moreno and others. Work was begun on left side of the Brazo Mistan River. Over 150 men are now working.

A reformed concession for a line of road from Cameron to Huatusco has been given by which the Government obligates itself to pay a subsidy of $3,500 a kilometre constructed and approved by the Department of Public Works.

Don Manuel Saavedra has been authorized by Congress to build a railroad from the port of San Benito and the town of Tapachula in Chiapas to connect with the proposed Mexican Southern. Work must begin within one year and completed in four years from the signing of the contract. The usual subvention is attached and this time it is for $8,000 a kilometre.

Sr. Federico Mendez Rivas, as representative of Sr. C. Policarpo Valenzuela, has received a concession for the construction of a railway, with a telegraph or telephone line, from the city of Cárdenas to the Grijalva River.

The Mexican National Railway has been finished as far as the city of Acámbaro, 286 kilometres (192 miles) from the city of Mexico.

The Government Inspector of the Morelos Railway has rendered his report of the work done in the month of April, showing material progress on the several sections from Mexico to Ozumba, Ozumba to Cuantla and Cuantlixco to Yautepec. The track from Cuantlixco to Yautepec has been inaugurated since April 1, and the traffic from Mexico to the latter point has been established.

The line of tramway between Matamoros and the Custom-House is finished.

The wash-outs on the Mexican Central between Leon and Lagos have been fully repaired, and trains are now running regularly.

The subscription books of the new Mexican Railway of the Central Table Land were opened in the City of Mexico June 11, at the office of the company.

The first locomotive on that section of the Interoceanic Railway between Irolo and Pachuca began running June 11, and from that date mule-power will be a thing of the past on the road. The time between Irolo and Pachuca will be shortened fully one-half, it is expected.

There are only 51 actual and projected railways in Mexico. Of these, 4 are finished, 50 are under construction, and 17 are projected. One of these lines belong to the Federal Government, 10 are without subventions and have not yet been undertaken, and 40 have been granted subventions varying from $5,000 to $9,500 to the kilometre. The Mexican Railway to Vera Cruz has an annual subsidy of $560,000. Four of these railways are operated by animal power, the others by steam.

AN ESCAPED INMATE from Flatbush Asylum recently laid his plans before a Brooklyn counsellor. They included the transformation of the Flatbush Asylum into a post-office and the construction of a ship canal from the East River bridge to Canarsie.

THE LONGEST BRIDGE IN THE WORLD.—This is in China, at Sangang, over an arm of the Chinese Sea. It is 5 miles long; the roadway is 70 ft. high, and stands upon 300 arches. The parapet is a balustrade, and each of the pillars, which are 75 ft. apart, supports a pedestal on which is placed a lion, 21 ft. long, made of one block of marble.

THE HOLLY MANUFACTURING COMPANY, Lockport, N. Y., recently closed a contract for two of the Holly-Gaskill Compound Condensing Horizontal Pumping Engines, each of 5,000,000 gallons daily capacity, for the Indianapolis (Ind.) Water-Works. The company guarantees a duty of 90,000,000 foot pounds per 100 pounds of coal.

THE ENGLISH IRON TRADE is now active, owing to increased demand from the United States. Numerous shipments have been made to take advantage of the new tariff.

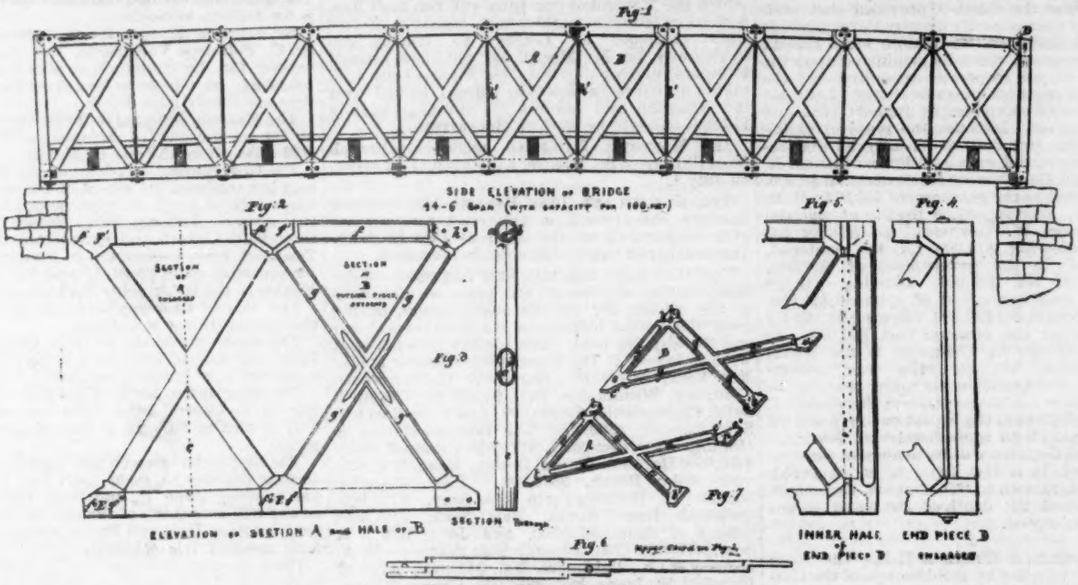
THE ENORMOUS GAS MAIN now being laid through the Westminster district is the largest in London. The diameter is four feet. Over twenty-three miles, in four diverging lines, have already been laid from the great gas-works at Beckton, the work having been begun ten years ago.

NEW ROADS.—*The Anniston & Atlantic Co.* has begun work on a line from Anniston, Ala., to Talladega and Goodwater. When this section is finished, the road will be extended through Gadsden to Gunter's Landing, on the Tennessee.... *Wood County Railroad Co.* (Mo.).—This road is to run from a point on the Wisconsin Central to a point on Wisconsin River. Length, 30 miles; capital, $100,000..... *The Central Pennsylvania Co.*—This line has been chartered; it will run from Mount Pleasant, Westmoreland County, to Punxsutawney, Jefferson County, a distance of 70 miles. The incorporators are officers of the Baltimore & Ohio Railroad. Building will be begun this season, as the line has been surveyed.

THE SHUTE CONTRACT.—The construction of the line from Cornwall, Ont., to Sault Ste Marie has been obtained, as before stated, by Mr. Shute of Philadelphia. It is now stated that the charter for building the line was granted some years ago, and that an air line was contemplated. The bridge charter was passed in last session of Parliament, and it is designed to build a high level bridge at Morris or Williamstown, east of Cornwall.

## TRUSS BRIDGES.

Dec. 24, 1861, James S. Zerk and G. H. Heming devised a bridge truss which, generally speaking, may be said to consists (1) in the employment of truss frames of metallic tubes bisected longitudinally; (2) in casting each of the longitudinally bisected sections of the panels in a single piece embracing a longitudinal half of the cross-bars and upper chord, and a portion of the shoe or heel-post, and (3) in the peculiar manner in which the shoes are formed and the panels united.

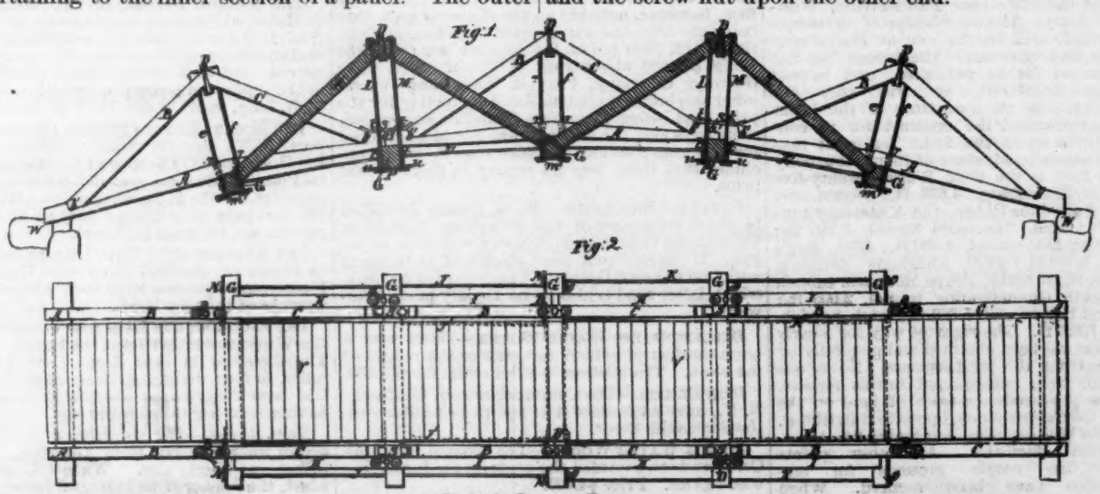



ZERK AND HEMING'S TRUSS.

Each panel, including the upper chord and cross-braces, is formed of half tubes *a* and *b* which, when put together, form the completed tube. The general constructon of the truss constitutes a united lap-joint at the upper and lower chords, and furnishes in itself that part of the shoe or heel part appertaining to the inner section of a panel. The outer sections are formed in the same manner, and when the two are put together, and any two panels joined, the joints and shoe or heel-posts on the lower ends of the cross-braces form a single tenon, as seen at *E*, Fig. 2. This tenon is received into a mortise formed in the lower chord made of wrought iron. By casting the panels together, including parts of the upper chord, cross-braces and shoes or heel blocks, the inventors state that they are able to dispense with a large number of bolts and a great amount of labor.

George H. Bruce sought to combine two bridge frames in such manner as to unite both frames in one bridge. Bruce's invention expired January 7, 1879. One of these frames, the inventor designates as the *arch frame*, and the other as the *truss frame*. A tongued wedge is also combined with each pair of the principal rafters in a manner to compensate for any shrinkage of the timbers or any sagging of the bridge, besides preventing any side slip of the rafters. The arch frame is composed of several arch beams *A* and truss-braces or principal rafters *B* and *C*. These rafters are connected at the top by the wedge *D* and are stepped on to the beams and suspension rods *e* and *f* at the foot.

The truss frame is composed of swing beams *G*. Suspension rods *L M* and tie-rods *J K* sustain the truss-braces or rafters *H I*. Each of the tie rods pass through three of the swing beams so as to tie together the two beams, upon which each pair of the rafters of the truss frame is stepped, as will be understood by the large head *N* upon one end of the rod and the screw nut upon the other end.




BRUCE'S BRIDGE TRUSS.

The swing beams are so placed when the two frames are put together that one of them will be directly under the apex of each pair of the truss braces of the arch frame, so that the suspension rods *e f* will form a stirrup under the swing beams.

*D* represents a wedge. The rafters are made a little short in order to admit of the wedge when the rafters are put together. By this means the timbers of the bridge may, at all times, be kept tightly together, so as to produce an equilibrium of strain upon all parts of the bridge.

The bottom chords *C* of J. R. Linville's bridge are com-